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THE HONEY BEE AT WORK

The parents of this worker were a drone and a queen bee. The drone is proverbial for laziness and helplessness. The only useful function in the economy of the hive that he performs is to fertilize the queen during the marriage flight, and very few drones ever do this. The queen is specialized to lay eggs. Neither of the parents is equipped with the workers' marvelous food gathering and housekeeping instincts. How these instincts have been transmitted for thousands of years through a line of queens and drones is an interesting problem in heredity. (Photo by David Fairchild.) (Frontispiece.)

HEREDITY IN THE HONEY-BEE

P. W. Whiting
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IT IS now generally recognized that inheritance in the honey-bee is of a criss-cross type due to the fact that males or drones arise from unfertilized eggs and thus inherit maternal characters only. Females, both workers and queens, come from fertilized eggs and thus show paternal as well as maternal qualities. These three castes are strikingly different from each other both in structure and in instincts. From measurements made by v. Alten and published by Armbruster it appears that the "brain-index" of workers is superior to that of the queen and the latter again superior to that of the drone. Degeneration of the queen brain is correlated with degeneration of instincts due to a "parasitic" life upon the worker colony. Instincts as well as brain of the drone are likewise far inferior to that of the workers.

PROBLEMS OF HEREDITY

In a recent book on bees ("A Book about the Bee" by Herbert Mace) occur the following remarks:

"The curious problem, and one that is not to be explained by any law that we are cognisant of, is that the workers with all their wonderful cell-building, pollen-gathering, and honey-storing appliances and instincts, descend from parents who have never done anything of the kind, having neither the organs nor the requisite amount of intelligence. How is this complex instinct transmitted?"

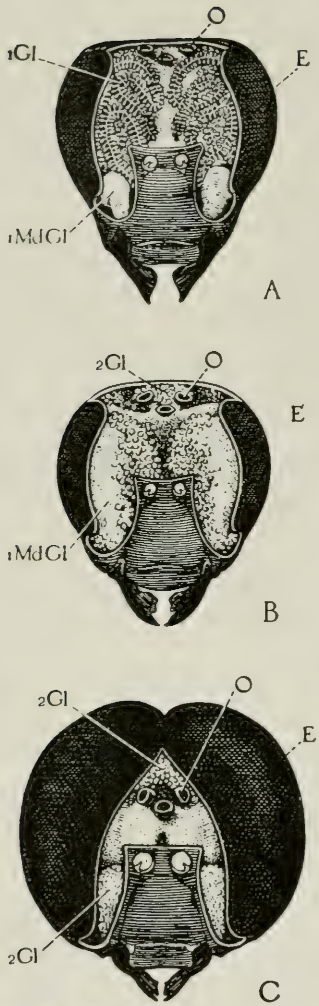
"The drone is a male bee, having neither the organs nor the intelligence to perform the necessary functions of existence apart from the colony. The queen is more or less in like case. Neither is able to find food for itself. Neither has ever had anything to do with the rearing of the young. Yet the product of the two is, under ordinary circumstances, an insect endowed with special apparatus for carrying home honey and pollen in quantities truly remarkable for the size of the creature. Its tongue, honey sac, and pollen baskets are developed in a measure that has no comparison with those of its parents. In addition it possesses a much higher degree of intelligence as calculated by brain area."

"The female or queen bee, contains within her own person the means of reproducing bees, but not bees that are in any way like herself. Her unassisted progeny is of a kind entirely different in its organic structure. In this she differs from the aphides. The offspring of a virgin aphis is like herself, a female."

" . . . drones have a mother, but no father. How comes it then that they possess the virtues, or perhaps we should say vices, of a parent who has taken no part in their production?

"Of course it is true that the drones which come from a certain queen are generally pure, that is to say, the particular variety of bee, whether Black, Italian, or Carniolan, which the queen belongs to is perpetuated in the drone."

"Skilled apiarists know well that qualities, even to the minute shades of difference are thus perpetuated. A stock that is naturally vicious and inclined to sting at every opportunity can be cured of the propensity by removing the queen and substituting one from another and more gentle colony. On the other hand if we have a colony which is notable for its devotion to work, for its capacity to extract honey from specially inaccessible flowers, or for the exceptional colour and beauty of its wax, we take great pains to rear future queens from that colony, knowing that their offspring will assuredly possess the same qualities. And yet, so far as we can trace back through the ages, the queen has never performed any of the duties so pre-eminent in her offspring."



ANTERIOR VIEW OF HEADS OF WORKER (A), QUEEN (B) AND DRONE (C)

The front chitin has been removed to show the internal glands, which vary in the three forms. There is marked variation in the size of the compound eyes at the sides of the head. After Snodgrass Bull. Bureau Ent. 28. (Fig. 1.)

Let us attempt from three different points of view to attack these problems that seem so perplexing.

THE GENETICIST'S METHOD OF ATTACK

In the first place we may consider the matter as viewed by the geneticist. There are numerous instances of transmission of qualities that appear only under the influence of particular environmental conditions. The germ plasm of any species doubtless has potentialities that are realized only under exceptional circumstances or not at all. Thus the factor for extra legs in Drosophila is inherited as a sex-linked gene, but the character appears only if development takes place at a cold temperature. A study of genetic literature reveals many other examples of masking of Mendelian differences by environment. In stock of uniform genetic character there may be considerable variation as a result of change of food, temperature, humidity, etc.

It may then be answered that workers are of the same genetic constitution as the queen, but a difference of food has dwarfed the ovaries and caused a greater development of brain and instincts. The fact that superior instincts have not occurred in any of the worker bee's direct ancestors is quite in line with the problem of heredity as viewed from the aspect of cell lineage. We receive our hereditary characters not from the body cells of our parents, but from the germ tract extending back indefinitely. The somatic cells of our ancestors are "sisters" to their germ cells, and "aunts" and "great aunts" to our own, just as worker bees are sisters to queens and drones and aunts and great aunts to later generations of workers.

The germ plasm of the honey bee has the capacity to develop worker as well as queen qualities, and the difference between worker and queen is determined by the food of the larva.

The difficulty which appears in the derivation of drones from virgin queens, is again due to the idea that characters are inherited as such from the parent. The drone does not derive its characters from egg-laying workers or unmated queens. On the contrary it derives a simplex assortment of genetic factors or of chromosomes in the unfertilized egg. This simplex condition determines the male, just as the duplex determines the female. If honey-bees were able to lay unreduced eggs, as are various species of parasitic wasps and aphids, then females would be produced parthenogenetically. Or if two sperm

nuclei could unite in an egg without an egg nucleus, then a female might result possessing all the racial characteristics of the father, but in every way a normal female.

The determination of sex then is not due to the source of the germinal material but rather to its quantity. In other words each caste,—drone, queen, or worker—transmits the very same genetic complex, including factors for racial differences in color, form, and instinct, and the genetic potentiality of producing male, queen or worker according to conditions. A simplex genetic assortment produces a male, a duplex produces a female,—a queen in case of royal feeding, a worker in case of worker feeding.

THE PHYLOGENETIC POINT OF VIEW

Let us consider the matter now from the point of view of phylogeny. What has caused the complicated instincts of the workers to be developed and what maintains these instincts at their present high level? In a word, how has natural selection acted upon the reproductive castes so carefully guarded and cared for by the workers?

For the one brief marriage flight of her life the queen must have strong wings to fly and keen senses to observe landmarks so that she may return to her hive. Failing in this one test she loses all chances of posterity. Moreover her mate must be superior to his fellows in speed of wing and sureness of vision. The marriage flight is indeed a eugenic test and selection of the superior male. Germ plasm then of queen and drone must bear factors for superior sensory apparatus and strong wings and muscles.

But the germ plasm of the royal pair must carry factors also for industry in collecting honey and pollen and in constructing combs and caring for the young or the colony as a whole will fail. Relatively high fertility must also be present for scarcity of eggs would result in small numbers of workers and scarcity of sperm would result in failure of fertilization giving excess of drones.

Natural selection acts upon the colony as a unit, and the character of the colony is genetically determined by the queen mother and her mate. The hive having greater industry, more socialized instincts, stronger wings and keener senses will survive under adverse conditions, show better capacity for adaptation, and thus have greater chances of posterity.

THE PHYSIOLOGICAL POINT OF VIEW

Finally from the physiological point of view there are numerous interesting problems concerning the differentiation of the castes.

It may be supposed that there are factors located in the various chromosomes tending to pull the course of development in the female direction. These would have a tendency to suppress male characters, both primary and secondary, but would stimulate the development of embryological fundaments of female characters. These factors are, however, too weak to act unless doubled, and hence the simplex condition produces a male, the duplex a female.

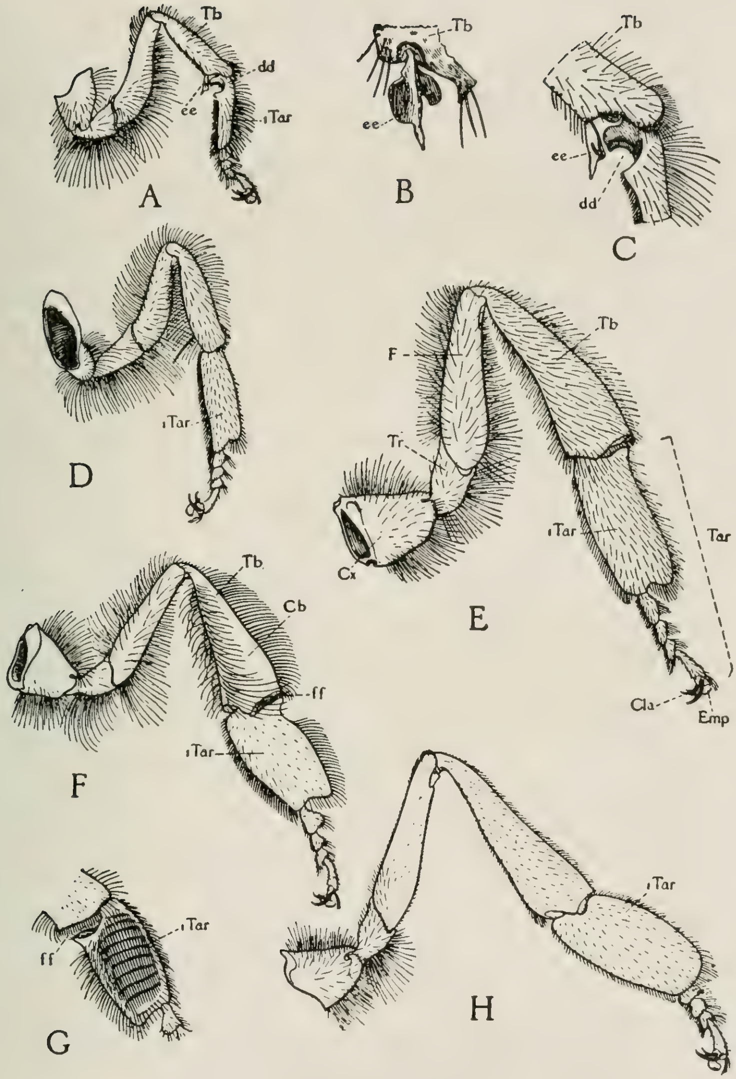
Queens and workers, although similar genetically, are distinct before they have had experience with the outer world. Differentiation is therefore due, not to active experience, but to feeding. A comparison may be made here with a situation in poultry. If ovaries be removed from a pullet, male form and plumage are developed, as well as male instincts, voice, etc. Now the effect of worker food in bees has been degeneration, or rather failure of development, of the ovaries. The queen may then be compared to the normal egg-laying hen, while the worker may be compared to the hen with ovaries removed, possessing characters that are normally suppressed by ovarial activity.

EGG-LAYING WORKERS

Intergrades between sexual and worker castes normally occur in bumble-bees, and in the honey bee, intergrades, such as egg-laying workers, are not unusual. Worker larvae, developing near queen cells, obtain royal jelly

THE WORKER, QUEEN, AND DRONE OF THE HONEY BEE

Both workers and queens are developed from a fertilized egg, and the difference in adult forms is brought about by feeding during the larval stage. The drones, or male bees, develop from unfertilized eggs, so that only maternal characteristics are inherited, as they have no fathers. After Phillips, Farmers Bull. 447. (Fig. 2.)



LEGS OF HONEYBEES

A, left front leg of worker, anterior view; *B*, Spine of antenna cleaner; *C*, Details of antenna cleaner; *D*, Left middle leg of worker, anterior view; *E*, Left hind leg of queen, anterior view; *F*, Left hind leg of worker, anterior view; *G*, Inner view of left hind leg of worker showing pollen-combs; *H*, Left hind leg of drone, anterior view. The honeybee carries many of its tools as leg appendages and these vary in the three types of bees. After Snodgrass Bull. Bureau Ent. 18. (Fig. 3.)

in addition to their regular worker food, and in this way are produced intermediate types resembling the bumble-bees in being capable of both work and reproduction, but probably of each to a lesser extent than the normal queen or worker. High specialization including differentiation of worker from queen has made for greater efficiency in the honey-bee colony.

AN HEREDITARY NOTCH IN THE EARS OF JERSEY CATTLE[1]

Superficial Appearance of This Character Would Appear to Fit Theory of Inheritance of Acquired Characters

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THE principal Jersey sire of the dairy herd at the Texas A. & M. College, Gamboge's Raleigh 109548, is characterized by a peculiarly shaped ear which he has transmitted to a large number of his calves. The author's attention was called to this upon his arrival at the Texas Experiment Station last September, and through the co-operation of Prof. R. L. Pou, head of the Dairy Department and W. L. Pou, dairy herdsman, it has been possible to make a tentative analysis of the genetic situation.

The case is particularly interesting in that the oddness of the ear shape consists of a notch on the lower edge of the ear which is very similar to a mark commonly used on the range for identification, the so-called "undersloped" or "underbit" ear. Hence many a casual visitor would assume that the bull's ears were artificially "undersloped," and the fact that his calves are born with "undersloped" ears would apparently constitute proof that an acquired character is being inherited. The origin of the mark could not be learned, for this bull is now over nine years old and was bought as a suckling calf by C. S. Gainer, Bryan, Texas. Mr. Gainer noticed the mark distinctly at the time and there then seemed to be no sign of a scar. A letter addressed to The White Horse Farms, Paoli, Pennsylvania, breeders of this bull, did not receive a reply and it is not known whether his sire or dam had this mark. Therefore, it is necessary to start with this bull in studying the situation, since knowledge of the notch begins with him.

Only one other case similar to this has been found. The Jersey bull, "Fern's Texas Lad" 96298, which was owned at one time by J. F. Houchins, Hallettsville, Texas, "had both of his ears marked with an underslope and

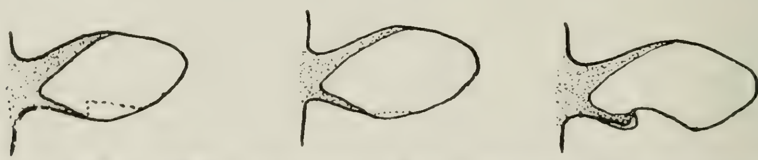

DIAGRAM SHOWING THE POSITION OF THE HEREDITARY NOTCH

On the left is shown the shape and position of the notch in the "underbit" ear, used as a mark by stockmen. The other two figures show the extreme variations in the size of the hereditary notch. (Fig. 4.)

[1] Paper No. 1, in Animal Genetics, from the Texas Agricultural Experiment Station.

GAMBOGE'S RALEIGH, WHOSE NOTCHED EARS ARE INHERITED BY HIS DESCENDANTS

The similarity of this notch to that in the artificially "underbit" ear would lead the layman to conclude that an acquired characteristic had been inherited. (Fig. 5.)

rounded crop,[2] and many of his get (but less than half of them) had this mark."

When viewed from the front the ears of Gamboge's Raleigh appear to have had a piece clipped neatly out of them. The outer end of the notch merges rather gradually into the natural curve of the ear, while the other end of the notch makes an acute angle with the ear's lower edge, leaving a sharp corner projecting downward and outward as shown in Figures 4–7. Close examination reveals the fact that this projection is really doubled in both ears, although more distinctly in the left than in the right. The doubling occurs as a front and a rear projection, and the groove between them is about a half inch deep in the case of the left ear and about a quarter inch deep in the case of the right. Some evidence of this doubling is visible in the pictures.

Were it not for the fact that so many of his offspring possess this notch, the condition could be regarded as an accident of development. It might be due either to a sporadic attempt at doubling of the ear or to a blocking of the blood vessel which would have supplied the missing portion of the ear during early embryonic life. Possibly this is the mechanism by which the hereditary factors act to bring about such a result, but there can be no doubt that this result is due to definite hereditary factors and not to mere prenatal accidents.

NOT SEX-LINKED

Thirty of the calves of Gamboge's Raleigh were examined personally by the writer and twelve were found to

[2] The expression "rounded crop" means to the stockman that the outer end of the ear has been cut off leaving it less pointed than is normal.

RIGHT EAR OF GAMBOGE'S RALEIGH

Quite often the development of the notch is greater in one ear than in the other, but the larger notch occurs just as often in the right ear as in the left. The notch in the left ear is slightly larger in this animal. (Fig. 6.)

be normal. At the time of examination the sex of twenty-seven of these offspring was noted, and fourteen females and three males were recorded among those with notched ears, and nine females and one male among those with normal ears. The excess of females is due to the fact that the bulls had been disposed of as soon as weaned, but most of the heifers had been retained, thus making more females available for examination. Had the character been a simple sex-linked recessive, it would not have shown in any of the offspring, while if it had been a simple sex-linked dominant it would have shown in all of the daughters but none of the sons.

Two calves sired by unrelated bulls, out of daughters of Gamboge's Raleigh, were examined. Both calves had normal ears. The mother of one of them had normal ears and the mother of the other had ears almost or quite as deeply notched as those of Gamboge's Raleigh, himself.

A SINGLE DOMINANT FACTOR

The only tenable hypothesis seems to be that the notched ear is due to a single dominant factor independent of sex. If Gamboge's Raleigh is heterozygous for this factor, his calves should be equally divided between those with notched and those with unnotched ears. The actual results of 12 normal and 18 notched, deviate only three from expectation. Since the probable error is 1.8, this deviation cannot be regarded as significant. The normal daughter produced a normal calf as expected, and the notched daughter, that should produce normal and notched calves in equal numbers, has thus far produced one normal calf. Further proof of this simple hypothesis waits upon the production of more calves by Gamboge's Raleigh and more calves from his daughters with the notched ears. Since he is a good individual and his daughters are excellent producers, it may be possible to inbreed or linebreed to him to secure animals homozygous for this factor, but since the notched ear has little economic importance in itself, it is not likely that any expensive plan centered on securing and demonstrating such homozygous individuals will be undertaken.

The degree of expression of the factor varies in different animals. The deeper notches are always accompanied by the doubling of the sharp projection but the shallower notches do not have this and in some cases the notch is barely more than a straight line cutting off a normally curved portion of the ear. Neither is the notch always

GAMBOGE'S RALEIGH'S LEFT EAR

In all the more deeply notched ears examined the projection at the inner end of the notch was always developed into two lobes. Perhaps this is an incipient double ear. (Fig. 7.)

equally expressed in both ears of the same animal, but it is as often the right ear as the left which is most deeply notched, and often the two notches are equal, although in Gamboge's Raleigh himself, the left ear is notched somewhat more deeply. In two individuals where the notch is rather shallow in one ear, the other ear is so nearly normal that it is a matter of opinion whether a notch is really present.

An inquiry concerning the inheritance of the notch was sent to former owners of Gamboge's Raleigh, and to present owners of his calves. C. S. Gainer of Bryan, Texas, who used this bull for several years, says he does "not remember any of his calves without the notch." J. F. Houchins of Hallettsville, Texas, who used the bull for a year, says that "all his calves except one, had the mark"; also "one of the daughters has freshened and the bull calf has an 'underbit' in only the left ear." Another daughter of Gamboge's Raleigh is described by her first owner as having the mark, and by her present owner as having a normal ear "unless there is a slight straightening at the point indicated; very slight indeed. Her calf has no mark of any kind at this place." Another daughter is reported as not having the notch, and as having a heifer calf which does not have the notch. A son is reported as not having the notch, but as having one heifer calf which does have the notch. All these cases, except the last one, agree with the hypothesis already stated, when the natural human tendency to remember peculiar individuals and forget ordinary ones, is taken into account. And before the last case can be considered a very serious objection, one would want to see this son of Gamboge's Raleigh and determine surely whether the notch was really absent or only rather small.

OTHER INTERESTING PHASES OF THE CASE

This character illustrates how easily the old ideas of quantitative inheritance might arise, particularly of a character diminishing in intensity rather uniformly as one traces it farther from the foundation animal. In this case, there is a rather clear line between notched and normal animals, but there are various degrees of notching and few of his calves are as deeply notched as Gamboge's Raleigh, himself. One may speculate as to whether this is due to chance, or whether the other hereditary factors of Gamboge's

THE RIGHT EAR OF A DAUGHTER OF GAMBOGE'S RALEIGH

This characteristic appears both in male and in female descendants, so that it is not sex-linked, for if it were it would either not appear in the progeny at all, or appear only in the daughters. (Fig. 8.)

LEFT EAR OF THE HEIFER WHOSE RIGHT EAR IS SHOWN ABOVE

There is no intrinsic value in these notched ears, but it is possible that such factors may be linked with those of economic value, so that their study is important in the breeding of improved strains of livestock. (Fig. 9.)

A CALF WITH SLIGHTLY NOTCHED EARS (Fig. 10.)

A CALF WITH DEEPLY NOTCHED EARS

There is considerable variation in the size of the notches, but the division between notched ears and normal ones is quite distinct. Very few of his descendants have ears as deeply notched as Gamboge's Raleigh. (Fig. 11.)

Raleigh are so grouped as to be unusually favorable to the expression of the notch factor. Most of his calves are either purebred Jerseys or out of grade Jersey dams, but one of those mentioned by Mr. Houchins was out of a cow that had no Jersey blood, and yet the calf showed the notch, indication that the character is not dependent upon a purely Jersey complex of factors.

Two pairs of twins are included in the list of offspring personally examined. The younger pair (shown in the pictures) gives every indication of being identical twins. Not only are they both heifers and both possessed of moderate notches in their ears, but their noses, tongues, switches, and shade of general body color, are the same and they have each a single white spot on the right hind foot. This, although but a single case, is worthy of mention in view of Gowen's conclusion

TWIN DAUGHTERS OF GAMBOGE'S RALEIGH

These heifers both have moderately notched ears. They appear to be identical twins, as they are alike in all other respects as well. Identical twins are developed from a single fertilized egg cell. Some investigators have concluded on statistical grounds that identical twins do not occur in cattle, so that this case is of interest in disproving such a theory. (Fig. 12.)

reached from a statistical study[3] that few or no identical twins are produced in cattle.

There is no intrinsic economic value in this notch just as there is none in the peculiar color markings of different breeds, but it is possible that other factors economically important, but difficult and expensive to trace, such as the factors for high milk and fat production, may be linked quite closely to the factor for the notch. The fact that the first daughters of Gamboge's Raleigh are showing up well at the pail will give an opportunity of seeking for linkage when more of them have begun production. Of course, the chances are against finding such linkage, since there are nineteen pairs of chromosomes in cattle,[4] but if enough of these non-economic characters are investigated, a few will ultimately be found which will serve as guides to the inheritance of the more important ones.

Finally, as we learn one by one in our breeds of livestock, of additional characters that are transmitted like those of Drosophila and other laboratory animals, the idea will be dispelled that domestic animals are a law unto themselves, untouched by the knowledge gained from the study of insects and rodents in genetics laboratories. When as many cattle as Drosophila shall have been examined carefully, it is not unreasonable to expect that as many hereditary factors will be discovered in them. A knowledge of the relations of large numbers of hereditary factors will ultimately offer a broader control of livestock breeding than a specific knowledge of the transmission of a few, irrespective of any practical value of the latter at present. Progress in livestock breeding in the near future will depend as much on the study of all classes of characters, regardless of whether they are economic or non-economic, as on an intensive study concentrated on one or two particularly valuable traits.

[3] Gowen, John W. 1922, "Identical Twins in Cattle?" Biol. Bull. Vol. 42, No. 1.

[4] Wodsedalek, J. E., 1920, "Studies on the Cells of Cattle with Especial Reference to Spermatogenesis, Oogonia and Sex-Determination." Biol. Bull. Vol. 38, No. 5.

MATRIMONIAL VIEWS OF UNIVERSITY STUDENTS

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THE presence of a substantial percentage of intellectually superior people, such as statesmen, scientists, captains of industry, clergymen, etc., is doubtless essential to the progress and prosperity of any race. Psychological and eugenical evidence indicates that intellectual capacity is inherited, and that environment merely furnishes the opportunity for the unfolding of innate mental powers. The future progress of a race, therefore, depends to a very large extent upon the rate of reproduction among its mentally superior individuals as compared with this rate among the mediocre or inferior. If, with the increase in numbers, there is either a relative or absolute decrease of able people, the race must suffer from lack of the adequate leadership which only such persons can provide.

It appears highly probable that the inborn mentality of college and university students is on the average higher than that of the population at large. This view is supported by the results of the mental tests in the United States Army during the late war.[1] The studies of Johnson and Stutzman,[2] Phillips,[3] Banker,[4] etc., show a surprisingly low birth rate among university and college graduates. An excellent review of these facts may be found in Popenoe and Johnson's Applied Eugenics.[5] The situation is far from encouraging to one who is interested in human progress.

MATRIMONIAL IDEAS OF PRESENT COLLEGE STUDENTS

Current investigations on the birth rate among college alumni must be confined to persons who graduated not less than twenty years ago, for assuming that man and wife are usually about the same age, alumni of a later date, if married, may yet have children. Consequently from such data one is unable to pass accurate judgment on the eugenic or dysgenic influences which have been operative in recent years. The writer believes it is important to discover what the college student of *today* thinks about matrimony and the family, for the ideas of intelligent young men and women influence their future conduct.

It is doubtful whether sufficient information of this kind could be obtained by personal conferences with students; they would probably hesitate to express themselves freely on all the questions asked. The temptation to make facetious answers must also be eliminated, as far as possible. Written questionnaires, to be returned to the investigator unsigned, constitute the best means of obtaining such data.

In April 1920 the writer mailed a matrimonial questionnaire to each one of the five hundred and fifty-five students then registered in the University of Mississippi. One set of questions was sent to the men, another to the women. Both questionnaires are reproduced below. Each

[1] *Proceedings of the National Academy of Science*, vol. XV.
[2] Johnson, R. H., and Stutzman, Bertha: "Wellesley's Birth Rate." *Journal of Heredity*, vol. VI, pp. 250-253, 1915.
[3] Phillips, John C. "Harvard and Yale Birth Rates." *Harvard Graduate's Magazine*, vol. XXV, no. 97, pp. 25-34, Sept. 1916. Also, *Journal of Heredity*, vol. 7, pp. 565-569, 1916.
[4] Banker, H. J. "Coeducation and Eugenics." *Journal of Heredity*, vol. 8, pp. 208-214, 1917.
[5] The Macmillan Co., New York, 1918.

student replied under oath (note the pledge at the top of the blank) and returned the questionnaire by mail, *unsigned*. Each one was thus free to express his or her inmost convictions without fear or embarrassment. By means of lectures on eugenics to the University classes in biology, which included nearly one-fifth of all the students, and a short article in the University weekly paper, the writer had impressed the student body with the importance of answering the questions seriously and accurately. Thirteen of the returned papers were discarded because either the oath was not taken or there was internal evidence of insincerity. There is every reason for believing that the remaining three hundred and twenty-eight returned questionnaires were filled out seriously and truthfully.

Eighty-five blanks were mailed to the women, four hundred and seventy to the men. Sixty-three women (74.1%) and two hundred and sixty-five men (56.4%) returned properly filled out blanks.[6]

The questions were designed to determine the percentage of students who prefer to marry, the average size of family desired, the objections to marriage, and the average kind of mate wanted.

Question four in the men's questionnaire, and five in the women's, was designed to cover the last point mentioned. As explained on the questionnaire, the qualities enumerated were to be indicated in the order of preference, "1" after a trait showing that it was the one most highly valued, "2" the second in the order of preference, and so on. Doubtless several characteristics were of equal value in the minds of many students, so it is unreasonable to stress too much the average evaluation of each characteristic. Yet in a broad way the results certainly show the general trend of student opinion. The average rating of each trait is shown in Table I (women) and Table II (men).

A glance through the list of traits in the sections devoted to mate selection shows that the student's answer must be of interest to the eugenist, who is concerned with perpetuating those inheritable characteristics which make for mental and physical vigor. Some of the qualities mentioned doubtless have slight eugenic value. On the other hand, general mental ability [Galton,[7] Thorndike,[8] Woods[9]], and health [Bell[10]] are certainly inherited, while artistic, musical [Davenport],[11] and business talents probably belong in the same category. Woods' work[9] indicates that moral qualities are transmitted; hence the student's valuation of sex purity, honesty and temperance doubtless are significant eugenically. The capacity to assimilate an advanced education [Terman],[12] [Army Mental Tests], or wealth indicates the possession of inheritable mental capacities above the average.

WOMEN'S QUESTIONNAIRE

Pledge—I hereby affirm upon my honor that I will, to the best of my ability, fill out the following questionnaire, seriously and truthfully.

....

(Place X here if you are willing to take this pledge.)

1. When circumstances permit, do you prefer to marry?.................... (Answer Yes or No.)

[6] I wish to take this opportunity to thank two of my former students in Genetics, Miss Rosa Hargis, and Miss Elizabeth Kimmons, for their faithful and painstaking assistance in recording and arranging the data derived from the questionnaires.

[7] Galton, Francis. "Inquiries into Human Faculty." London, 1907. "Heredity Genius," London, 1914.

[8] Thorndike, E. L. "Educational Psychology." Teacher's College, Columbia University, 1910.

[9] Woods, Frederick Adams. "Heredity in Royalty." New York 1906.

[10] Bell, Alexander Graham. "The Duration of Life and Conditions Associated with Longevity." Genealogical Record Office, Washington, D. C., 1918.

[11] Davenport, C. B. "Heredity in Relation to Eugenics." Henry Holt and Co., 1911.

[12] Terman, L. M. "The Measurement of Intelligence." Houghton, Mifflin Co., 1916.

2. If you do not prefer marriage, please state your objections to it.
3. If a young woman has a favorable opportunity to marry, do you think she should reject it in favor of a career? (In medicine, teaching, business, etc.)

....

(Answer Yes or No.)
4. Underscore the number of sons and daughters which you think would constitute an ideal family:
Sons—0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10.
Daughters—0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10.
5. If you are favorably disposed to marriage, please fill out the table below, thus indicating the relative importance you attach to the qualities of a prospective husband. For instance, if you consider social ability the most important characteristic for a husband to have, place 1 after "social ability" in the table. If you consider disposition the next most important consideration, place 2 after "disposition," and so on through the list.
a. Personal neatness.
b. Prominence.
c. Artistic ability.
d. Good looks.
e. Natural mental ability.
f. Disposition.
g. Interest in religion.
h. Honesty.
i. Social ability.
j. Sex purity.
k. Education.
l. Willingness to rear a family.
m. Abstinence from use of tobacco.
n. Abstinence from use of liquor.
o. Abstinence from use of drugs.
p. Attitude on woman's suffrage.
q. Health.
r. Ambition.
s. Fondness for sports.
t. Family connections.
u. Business ability.
v. Mutual intellectual interests.
w. Native State or Section of country.
x. Wealth.
6. Have your views regarding matrimony changed since you entered this University?........................
If, so, what were your views previously, and why did you change them? (If you have previously attended any other college or university, indicate any change of views since coming to this University.)
7. Age.
8. School and class in University.
9. Home state or county.
10. Married.

You are not expected to sign your name to this questionnaire. Please mail the questionnaire, filled out, to H. R. Hunt, University, Miss., before April 24, 1920.

The above is the questionnaire which was mailed to the women students. Ninety-eight per cent of the women expressed their preference for married life. Seventy-four per cent of them believed that a woman should marry even if given a chance to enter upon a career. Of the sixteen women (26%) who believed that a woman should reject matrimony for a career, fifteen answered question 1 affirmatively, indicating that they were not emotionally averse to marrying. Obviously they are not "men haters." Banker, working on the data from Syracuse University, suggests that the University curriculum attracts women who, on the average, are somewhat abnormal in their sex reactions. While the evidence indicates that there may be some women of this type in the University of Mississippi, they do not at the most constitute more than a fourth of the women students, and the fact that nearly all answered the first question affirmatively strongly supports the view that they have fairly well developed domestic instincts.

Sixty women replied to question 4. The averages computed from the answers to this question are 2.1 sons and 1.9 daughters. This practically amounts to a family of four children. The minimum number of children mentioned was two and the maximum six.

Question 4 does not bluntly ask each woman how many children *she desires* to have. Such directness might have aroused an antagonism which would have kept many from answering the question at all. It seems likely, however, that the "ideal family" would be the goal toward which any woman

would strive, health and financial resources permitting.

It is gratifying to know that the childless family does not find favor among the women students of the University of Mississippi. On the contrary, their views at present will doubtless influence a large part of them to marry and become the mothers of families of several children each.

The results of question 5 are shown in Table I. The left column gives the characteristics of the prospective husband, and the column at the right shows the *average* of all the ratings for each characteristic. The answers of fifty women were sufficiently complete to be used in making this table.

Table I

Characteristic	*Average rating*
Sex purity	1.7
Honesty	4.5
Disposition	4.4
Health	5.6
Natural mental ability	7.3
Education	8.0
Abstinence from liquor	8.5
Abstinence from drugs	9.0
Ambition	9.2
Interest in religion	10.0
Business ability	10.3
Personal neatness	10.3
Willingness to have family	13.3
Mutual intellectual interests	13.5
Family connections	14.3
Prominence	15.6
Social ability	16.6
Good looks	16.9
Abstinence from tobacco	17.8
Artistic ability	18.5
Fondness for sports	18.6
Wealth	19.5
Native state or section	22.0
Attitude on woman suffrage	22.1

"Sex purity" receives first place with a rating of 1.7. Seventy-four per cent of the women graded this "1." The writer should have used the term "chastity" to express his intent instead of "sex purity," for it was found after the data had been tabulated that some of the women who filled out the questionnaire had in mind freedom from venereal infection rather than chastity. A woman student of mine questioned on this point thirty-two of the women who sent in the questionnaire. Eighteen of them had interpreted "sex purity" as freedom from venereal disease, fourteen took it to mean chastity. All informed her, however, that they regarded male chastity and freedom from venereal infection as being of equal importance. Doubtless chastity holds a very high place in the minds of these women, though it is impossible to assign it to a definite place in this series.

"Honesty" and "disposition" are next on the list and are of about equal rank. "Honesty" received four per cent of the "1" ratings, and "disposition" two per cent. If morality is to a large extent inheritable (Woods: See footnote 9) the high grading of "honesty" is eugenically fortunate.

"Health" and "natural mental ability" also rank high. "Health" was given six per cent of the "1" ratings, while "natural mental ability" received ten per cent of them. Both are believed to be inheritable. Consequently these ratings are eugenic.

As might be expected "education" holds a high place on the list. It is slightly above "abstinence from liquor." This is interesting in view of the fact that the latter depends partly on the former.

"Abstinence from drugs" and "ambition" are rated nearly the same.

"Interest in religion," "business ability," and "personal neatness" come next. Religious inclinations are graded distinctly below all the moral qualities. May it not be that the students regard religion and theology as synonymous?

It is unfortunate eugenically that personal neatness ranks so much higher than "willingness to have a family" or "family connections." It is far less important eugenically to keep one's trousers pressed, etc., than to bear children, if one comes of good stock. It is far more important for a young woman to scan a suitor's relatives to form an estimate of his, and his prospective children's, quality, than to be particular about his clothes. It has been suggested, however, that most of the students when rating "family connections" had in mind some of the pseudoaristocrats, of no particular eu-

genic worth, who attempt to copy the manners and life of real aristocrats.

As might be expected, "good looks" are not of paramount importance to the women.

The low place assigned to "fondness for sports" indicates that the women's judgment in mate selection has not as a rule been much influenced by the glamor of the college athlete.

"Wealth" is near the bottom of the list. The acquirement of wealth depends as a rule upon the possession of moie than average ability. Assuming that wealthy men usually marry into good stock, their sons should usually be above the average in ability, and therefore desirable mates eugenically. For these reasons it is unfortunate that the possession of wealth is held in such low esteem by these fifty young women.

A small minority (13%) have changed the views on marriage since entering the University. Almost all of these said that they had come to want a higher type of husband, or to regard matrimony more seriously in one way or another since entering the University.

The above facts show that the young women in the University of Mississippi certainly have on the whole sound ideas, socially and eugenically, on the question of matrimony.

MEN'S QUESTIONNAIRE

Pledge. I hereby affirm upon my honor that I will, to the best of my ability, fill out the following questionnaire seriously and truthfully.........
(Place X here if you are willing to take this oath.)

1. When circumstances permit, do you intend to marry?...................
(Answer Yes or No.)

2. If you do not intend to marry, please frankly state your objections to matrimony.

3. Underscore the number of sons and daughters which you think would constitute an ideal family:
Sons—0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10.
Daughters—0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10.

4. If you contemplate marriage, please fill out the table below, thus indicating the relative importance you would attach to the several qualities of a prospective wife. For instance, if you consider social ability the most important characteristic for a wife to have, place "1" after "social ability." If you consider disposition the next most important consideration, place "2" after it, and so on through the list.

a. Housekeeping ability.
b. Artistic or musical ability.
c. Education.
d. Natural mental ability.
e. Disposition.
f. Interest in religion.
g. Moral character.
h. Willingness to rear a family.
i. Beauty.
j. Social ability.
k. Health.
l. Fondness for sports.
m. Ambition.
n. Family connections.
o. Business ability.
p. Wealth.
q. Mutual intellectual interests.
r. Native state or section of country.
s. Attitude on woman's suffrage.

5. Have your views concerning the desirability of matrimony changed since you entered the University?.... If so, what were your views previously? Why did you change them? (If you have previously attended any other college or university, indicate any change of views since coming to this University.)

6. Age.

7. School and class in University.

8. Home state and county.

9. Married?

You are not expected to sign your name to this questionnaire. Please mail the questionnaire, filled out, to H. R. Hunt, University, Miss., before April 24, 1920.

Ninety-eight per cent of the men said that they intended to marry. The average of all the answers to question 3 (referring to the composition of the ideal family) is 2.5 sons and 1.8 daughters—in round numbers a family of four children. The range of choice is from none (one case) to ten children. Evidently the University men, like the

women, are opposed to childless families.

Table II is a tabular digest of the replies to division 4 of the men's questionnaire.

Table II

Characteristic	*Average for all men*
Moral character	1.9
Health	3.8
Disposition	3.9
Education	5.5
Natural mental ability	6.4
Willingness to rear family	8.0
Interest in religion	8.4
Housekeeping ability	8.7
Beauty	8.9
Ambition	10.1
Social ability	10.4
Family connections	11.3
Artistic or musical ability	11.5
Mutual intellectual interests	12.7
Business ability	12.9
Wealth	14.2
Fondness for sports	14.3
State or section	17.0
Attitude on woman suffrage	17.7

The table gives the average ratings for each of the characteristics. It was compiled from the answers of two hundred and forty-four men from all departments and years of study in the University.

"Moral character" easily heads the list in this column. It is unfortunate that this point was not subdivided into chastity, honesty, etc., yet chastity was no doubt the trait that most of the men had in mind in grading this point. The high rating of morality is fortunate eugenically, as previously indicated.

"Health" and "disposition" come next, and are rated about the same. This emphasis on health is eugenically desirable, as mentioned before.

Next comes "education," then "natural mental ability." A person can not proceed far with the first without the second. Natural talent is ranked high, as it should be in any eugenic scheme.

"Willingness to rear a family," "interest in religion," "housekeeping ability," and "beauty" follow in the order named. The fact that religious interests are separated so clearly from moral character indicates that the men students had the theological aspects of religion in mind, for the most part, in rating this point. The fact that physical attractiveness in a woman is so distinctly subordinated to her morality, health, education, and intelligence, shows that the University men are influenced in their matrimonial ideas more by their intelligence than by their sex passions.

The comparatively low rating of "social ability" shows that a "social butterfly" is not particularly desired.

It seems to the writer that "wealth" and "family connections" should not have been ranked below "social ability." As a rule wealthy women probably come from families of superior mentality, for the acquirement of money doubtless depends to a large extent on inheritable mental abilities. A woman's membership in a "good family" should favor the development of desirable traits in her children. But possibly here too the existence of many innately mediocre families who strive to imitate genuine aristocrats has led the University student to regard family connections as unworthy of serious consideration.

Table III is a comparison between the data of Tables I and II. The left column shows the order of characteristics as arranged by the men, with those traits omitted which were not in the women's questionnaire. Similarly the right column shows the traits as arranged by the women, with those characteristics left out which were not inserted in the men's questionnaire. This treatment makes it possible to compare the women's average ideal of a mate with the men's. In the women's column "sex purity" and "honesty" have been combined in one and considered equivalent to "moral character."

The men and women practically agree on the high ranking of morality, health, disposition, education, and native mental ability. In short, they agree on the social and eugenic fundamentals. The men rate the willingness to have a family and physical attractiveness significantly higher than do

the women. This is, of course, what would have been expected. Conversely the women rate the following traits significantly higher than the men do: ambition, business ability, and mutual intellectual interests. As would be expected, the women emphasize more than the men the importance of business sagacity and the determination to succeed. "Interest in religion" is rated the same by both sexes. There are other slight, though not very significant, points of agreement and divergence between the ideals of the two sexes. The results of this comparison agree well with general experience. This agreement greatly strengthens the belief that the students were conscientious in filling out their questionnaires.

Two hundred and nineteen men answered question 5. Thirty-five (16%) of these stated that their views regarding the desirability of matrimony had changed since entering the University. The replies of only five (2.3% of the whole) indicated that the change had been for the worse, judged by conventional standards. In eleven cases it was difficult to decide whether the change in views had been beneficial or harmful. The majority, nineteen, had changed for the better. These results certainly indicate a wholesome moral atmosphere in the University of Mississippi.

TABLE III

Men's Questionnaire	Women's Questionnaire
Moral character	Moral character (sex purity and honesty)
Health	Disposition
Disposition	Health
Education	Natural mental ability
Natural mental ability	Education
Willingness to rear family	Ambition
Interest in religion	Interest in religion
Beauty	Business ability
Ambition	Willingness to have family
Social ability	Mutual intellectual interests
Family connections	Family connections
Artistic or musical ability	Social ability
Mutual intellectual interests	Good looks
Business ability	Artistic ability
Wealth	Fondness for sports
Fondness for sports	Wealth
State or section	State or section
Attitude on woman's suffrage	Attitude on woman's suffrage

In criticising the student's ideas on mate selection the writer does not wish to imply that the desirability of a mate depends entirely upon his or her worth from the standpoint of heredity. Manners, physical attractiveness, temperament, and other characteristics that stimulate the emotions of others

have an important place. But young people should be induced to form those sentimental attachments that will lead to racial betterment rather than deterioration.

The importance of environment in providing the fertile soil in which the seeds of hereditary promise may grow, should not be minimized. But the prevalence in democracies like ours of the fallacious dogma of human equality makes it imperative to emphasize the fundamental importance of heredity.

SUMMARY

It is impossible to say to what extent the views of these students will affect their future conduct with reference to matrimony, but undoubtedly there will be an effect.

For the most part the attitude of the students in the University of Mississippi is morally and eugenically good. Almost all the men and about three-quarters of the women intend to marry, if circumstances permit. The average size of family preferred is four children. This number is sufficient to replace this group in the next generation. The relative rating of those traits which are usually considered in choosing a husband or wife are morally, and for the most part eugenically, sound. Doubtless the questionnaires were filled out by the better class of students, since one would naturally suppose that such students would be most likely to take an interest in an investigation of this kind. If this assumption is correct, these findings are particularly gratifying. As far as can be determined the changes in attitude toward matrimony have been mostly for the better, showing that the moral .atmosphere of the University is good.

A German Statement of Eugenics

Grundriss der Menschlichen Erblichkeitslehre und Rassenhygiene, Band II: Menschliche Auslese und Rassenhygiene, von Dr. Fritz Lenz, privatdozent für hygiene an der Universität München, pp. 251, preis des I u. II Bandes in 1 Band gebunden, $2.60; München, J. F. Lehmanns Verlag, 1921.

One of the encouraging facts about the science of eugenics is that it has now become somewhat stabilized. Take the presentation of the leaders of the movement in the United States, England, France, and Germany, for instance, and there will be found to be remarkably little divergence among them, on fundamental questions of eugenic policy. The present book, which is quite the best I have seen from the Continent, gives a sound and conservative account of natural and artificial selection in man, of "social race hygiene" and of "private race hygiene." Although it is not well documented, it will be of great interest to all in the United States who are concerned with the eugenics movement. In Germany it has already gone into a second edition.—P.P.

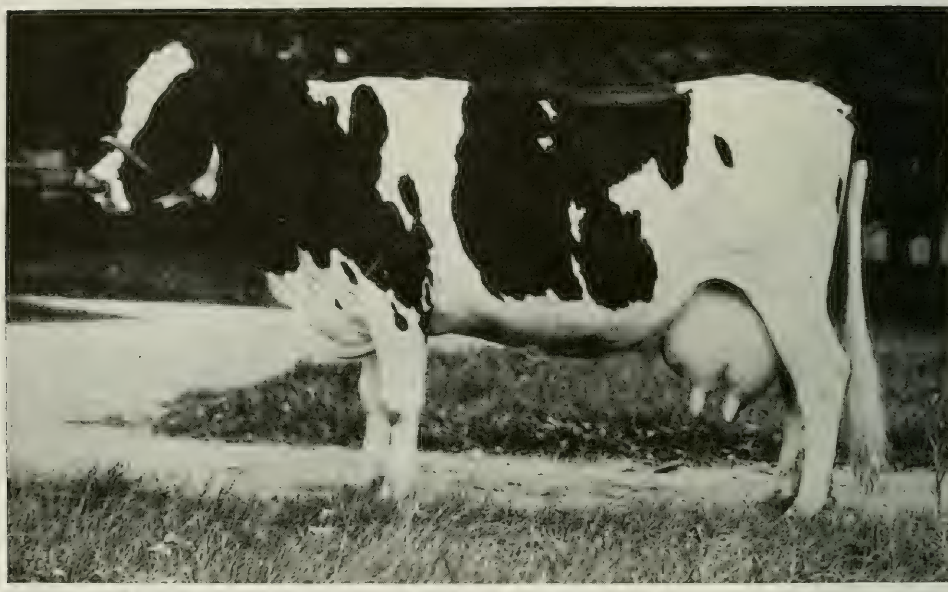
Biology and Religion

The Direction of Human Evolution, by Edwin Grant Conklin, professor of biology in Princeton University. Pp. 247, price $2.50. New York, Charles Scribner's Sons, 1921.

This series of lectures, delivered on a foundation calling for discussion of the mutual bearings of science and religion, will give the reader who has little acquaintance with biology a good idea of some of the broader fundamental concepts. Its widespread perusal should help to make for a better understanding of the application of the doctrine of evolution to many important problems of human philosophy and politics.—P.P.

A CASE OF TWINNING IN DAIRY CATTLE

C. C. HAYDEN
Ohio Agricultural Experiment Station, Wooster



GRACE DARLING HENGERVELD 242862, DAM OF FIVE SETS OF TWINS AND TWO SINGLES (Fig. 13.)

GRACE DARLING HENGERVELD, 242862, a purebred Holstein-Friesian cow, known as No. 90 (Fig. 13) in the Ohio Agricultural Experiment Station herd, has conceived twins five times out of seven.

Grace belongs to a prolific family. Her granddam (No. 57) is now 14 years old and calved the 11th time, November 21; 65 calves have been born in the herd from her and her female progeny. Four females which might have produced additional progeny by this date were sold, and two died. Had the four not been sold, 10 more might have been added. Of the progeny, 31 were females and 34 were males.

The great-granddam (No. 33) of Grace Darling Hengerveld was bred to a son of Sarcastic Lad, and produced No. 57. She was again bred to the same sire and produced twins—male and freemartin.

No. 57 was bred to her sire and produced No. 70, and later a set of twins—male and freemartin. Bred to Marcella Hengerveld De Kol, she produced No. 107, who gave birth to one set of twins—male and freemartin.

No. 70 gave birth to nine calves including No. 90 (the cow mentioned above) who has calved as follows:

1st, No. 124 by her own sire, Marcella Heng. De Kol 70519.

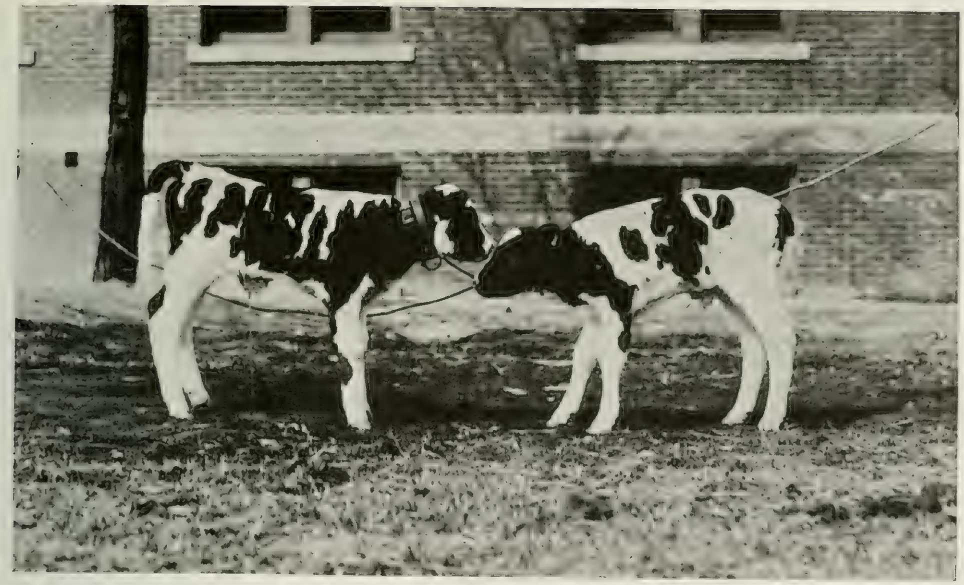
2d, twins, males, by her own sire Marcella Heng. De Kol 70519.

3d, No. 163, by her own sire, Marcella Heng. De Kol 70519.

4th, twins, males, (aborted) by King Pontiac De Kol Spr. Brook 150875.

5th, twins, male and freemartin, by same bull.

6th, twins, male and freemartin, by same bull.

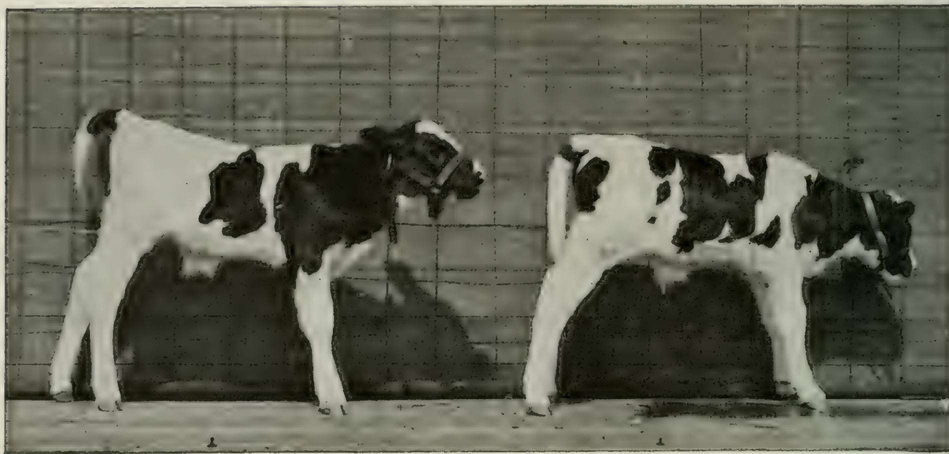


GRACE DARLING HENGERVELD'S FIRST TWINS

They were by her own sire; born Mar. 10, 1915. Photo taken at two days of age (Fig. 14.)

GRACE DARLING HENGERVELD'S TWINS SIRED BY K. P. DE KOL SPRING BROOK

Born Mar. 10, 1919. Photo taken at three months of age (Fig. 15.)



GRACE'S LAST TWINS BY MEADOW HOLM JENNIE KING
Born Mar. 29, 1921. Photo taken at six days of age (Fig. 16.)

7th, twins, males, by Meadow Holm Jennie King, 218701.

Note that she has twinned to service by three bulls.

It has been suggested that one might develop a family of cows which would produce a high percentage of twins; but of the nine sets of twins in this family, six sets were male and freemartin and three sets were males. Was it mere chance that there was no set of females? Three of the freemartins were kept until of breeding age. Only one came in heat and was bred, but failed to conceive. An exanination of the vagina showed it to be abnormal.

The cows in this family are good producers as well as reproducers:

The highest record of No. 57 was 21,177 lbs. milk, 888 lbs. 80% butter.

The highest record of No. 70 was 17,492 lbs. milk, 740 lbs. 80% butter.

The highest record of No. 107 was 22,161 lbs. milk, 940 lbs. 80% butter.

The highest record of No. 124 was 20,377 lbs. milk, 953 lbs. 80% butter.

No. 90's entire milk and butter record is as follows:

Period	*lbs. milk*	*lbs. 80% butter*	*Days in milk*
1st......	9,634	455	360
2d......	13,147	643	388
3d......	19,966	953	500
4th......	12,971	591	362
5th......	21,528	1023	658
6th......(incomplete)			

She is now nine years old and producing well during her 6th lactation period. She has never been officially or semi-officially tested for advanced registry.

The calves produced by these cows, of which 30 were males, and 23 were females and freemartins, were as follows:

Cow	1st	2d	3d	4th	5th	6th	7th	8th	9th	10th	11th
No. 33	?	M	M	F	F	F	?	M&F			
No. 57	F	M	M	F	F	M	M	M&F	F	F	M
No. 70	F	F	M	M	M	F	M	M	M		
No. 107	M	F	F	M&F	M	F					
No. 90	F	M&M	F	M&M	M&F	M&F	M&M				
No. 124	M	M	M&F	F	M						

THE TEMPERATURE OF THE MELTING POT[1]

(A Review)

THERE is a general belief that the melting pot is not functioning in the United States and that the immigrant races largely remain foreigners. Dr. Pearl assumes the contrary position and shows by an analysis of the birth records for a large part of the United States, including our large foreign settlements, that hybridization and race fusion are going on apace and that a new race is being evolved here in America that within the next two centuries will have supplanted completely the relatively pure racial stocks from Europe.

"Science tries ever to peer into the future, and nowhere is the desire to estimate what the future has in store stronger than in the case of matters relating directly to human actions, emotions and thoughts. This general interest of man in his future social, physical and mental evolution crystallizes in a specific way for us here and now in the problem of the future American civilization. Our gates have been open, with some slight and on the whole insignificant exceptions, to all and sundry. Good, bad, and indifferent people have been free to settle here, and have made the fullest use of the freedom. The problem is to determine to what extent racial amalgamation or fusion occurs." Dr. Pearl has attempted with the limited data available to gain an insight into this problem and in the course of a statistical analysis has uncovered some important and hitherto unsuspected facts.

An analysis of the growth of a population in an area of fixed limits leads to the prediction that, "strange and inconceivable as it may appear to many persons, the United States is going to be sometime a densely crowded country where each individual, consciously or unconsciously, will be challenging the right of every other individual to existence. And further, the time when this pressure of population will be felt definitely in this country is not far away and by every present indication in less than two centuries we may expect a degree of pressure of population upon means of subsistence which will make the everyday life of everybody a different thing entirely from the prodigally wasteful business it now is. We shall be uncomfortably close to the limit of population by 2100 at a time which the great grandchildren of a number of persons now living will be components of the population. What *kind* of a population will that be? What elements now in the population will then, and in the succeeding years, be the dominant ones? Or, will none of the racial groups now so distinct in our population exist as such then, having in the meantime fused and amalgamated, one with the other, till there remains only a biologically homogeneous whole? These questions cannot be answered positively today but present *tendencies* and past experience can be examined."

"The United States has been, from its beginning a gigantic experiment in human genetics." The degree to which the admittedly large mass of immigrants who have found their way to our shores is being absorbed by the native population and fused into a new race has been a matter of much speculation both in and out of print. Very little definite information has been available due chiefly to the lack of funds for compiling existing data and to the failure to collect some of the much needed information.

"Vast quantities of ink have been spilled in the discussion of the 'melting pot' in America. It would be unbelieveable if it were not true, in view of the

[1] Review of an article "The Vitality of the Peoples of America" by Dr. Raymond Pearl, Amer. Jour. of Hygiene, Vol. I., Nos. 5 and 6, Sep.-Nov., 1921.

interest in this subject, and its obvious importance as a factor in national well-being, that no data are available by which the degree or extent of the 'melting' or racial fusion can be measured on a national scale."

In spite of the lack of accurate information or probably because of it there is a general belief that the immigrants are not being absorbed and are remaining, in restricted colonies, essentially foreigners. Pearl's analysis of the Census data for the Birth Registration Area leads him to the opposite conclusion. "That newly arrived foreigners rather speedily fuse effectively with the stocks already here, to a degree much greater than is presupposed, at least in most popular discussions of the subject of immigration and related matters."

"For the entire Birth Registration Area the percentage of amalgamation or fusion of foreign-born stocks with native-born as compared with racially like effective matings of all sorts is just under 11.5 per cent. That is, for about every ten effective marriages in which the partners were of like nativity there was one in which one partner was of American and the other of foreign nativity. On the whole this appears a reasonably large proportion, when one considers inherent prejudices which must be overcome before such marriages can occur. Of course one realizes fully that some unknown, but certainly significant proportion of this American × foreign-born cross matings really are not racially cross at all but like, one partner merely having been born in the United States. But fully granting this, there are two further points to be noted, namely: first, that American birth and upbringing to marrying age tend to create a considerable measure of antipathy or prejudice towards the more recent immigrants of the same race. In making this statement the writer relies upon his own personal observations of foreign stocks in this country. In many cases the American-born child of foreign parents desires passionately to be a 'pure American,' to slough off and forget the attributes which characterize, as he or she thinks the 'wop' using this in a generic term of disparagement for the foreigner."

"In the second place it must be remembered that in 816,546 effective marriages of native-born there are many racially unlike matings. In three states, Massachusetts, New York and Connecticut, there were actually in 1919 as many or more matings in which both parents were foreign-born as there were where both parents were native-born, and in New Hampshire, Pennsylvania and Maine, the effective foreign ×foreign matings were more than half as numerous as the effective native× native matings. There can be no doubt that in these six states the less Americanized elements are multiplying too fast in proportion to the more Americanized elements."

Many students will take issue with the author's statement that the American-born persons of foreign parents have an antipathy toward marrying recent immigrants of the same race. This hardly can be considered as a prevailing sentiment in those sections where large foreign colonies predominate. Dr. Pearl's observation seemingly would apply only to those regions where the relative number of foreign whites was small. The degree of error arising from this source may be negligible but the lack of available data precludes its determination. While it is true that in the United States × United States group there are many racial crosses, it is equally true that in this same group there are many more crosses between members of the same foreign race which, from the narrow genetic standpoint of race amalgamation, are just as pure racially as if their parents had been born abroad.

But this source of error is discounted by the author who reasons that the only definition of an American is that of nativity. "An American is a person born in the United States [with apologies to the Canadians]. The only racially pure American is the Amerind. I can not see logically but that a person born in the United States in 1920 has just as much right to call himself an

American as one born here in 1620. And further this right is just as logically passed on hereditarily now as it was then." "Practically and in fact that is the way in which Americans of all varieties including that odd and rather dangerous creature now so much to the fore, the '100 per cent American,' have come into being!"

Leaving this debatable ground a study of Table V which has been reproduced here will show that there is a truly astounding amount of racial hybridization. Giving all sources of error their due weight and being reasonably severe with the United States ×United States group it seems safe to conclude that approximately 10 per cent of the children born in 1919 were first generation hybrids!

TABLE V. *Net effectiveness in producing next generation.*

Order	Race combination	Number of Births	Per Cent	Order	Race combination	Number of Births	Per Cent
1	U. S.×U. S.	816,546	65.123	42	Austria×Italy	323	.026
2	Italy×Italy	76,251	6.081	43	Canada×other foreign	315	.025
3	Russia×Russia	53,128	4.237	44	Germany×Poland	313	.025
4	Austria×Austria	46,407	3.701	45	U. K.×Germany	309	.025
5	Other foreign×other foreign	30,079	2.399	46	Scandinavia×U. K.	283	.023
6	U. S.×Canada	24,181	1.929	47	Scandinavia×Germany	278	.022
7	Poland×Poland	22,562	1.799	48	Hungary×other foreign	242	.019
8	U. S.×Germany	16,520	1.318	49	Ireland×other foreign	238	.019
9	Hungary×Hungary	14,624	1.166	50	Canada×Scandinavia	221	.018
10	U. S.×U. K.	14,339	1.144	51	Canada×Germany	220	.018
11	U. S.×Italy	12,559	1.002	52	Ireland×Germany	187	.015
12	U. S.×other foreign	12,234	.976	53	Scandinavia×Ireland	162	.013
13	Ireland×Ireland	12,035	.960	54	Poland×other foreign	161	.013
14	U. S.×Scandinavia	11,454	.914	55	Austria×U. K.	154	.012
15	U. S.×Russia	10,519	.839	56	U. K.×Italy	143	.011
16	Canada×Canada	9,616	.767	57	Ireland×Italy	139	.011
17	U. S.×Austria	9,600	.766	58	Canda×Italy	131	.010
18	Scandinavia×Scandinavia	9,519	.759	59	Italy×Russia	120	.0096
19	U. S.×Ireland	9,006	.718	60	Germany×Italy	110	.0088
20	Germany×Germany	6,595	.526	61	Canada×Russia	86	.0069
21	Austria×Russia	5,791	.462	62	Hungary×Italy	84	.0067
22	U. K.×U. K.	5,444	.434	63	Austria×Canada	79	.0063
23	U. S.×Poland	4,521	.361	64	Austria×Ireland	76	.0061
24	U. S.×Hungary	1,829	.146	65	Hungary×Poland	70	.0056
25	Russia×other foreign	1,447	.115	66	Austria×Scandinavia	68	.0054
26	U. K.×Ireland	1,161	.093	67	Italy×Poland	68	.0054
27	Austria×Germany	1,153	.092	68	Scandinavia×Russia	57	.0045
28	Canada×U. K.	1,001	.080	69	Scandinavia×Italy	40	.0032
29	Austria×other foreign	946	.075	70	Hungary×U. K.	36	.0029
30	Austria×Hungary	944	.075	71	Ireland×Russia	36	.0029
31	Austria×Poland	889	.071	72	Canada×Poland	33	.0026
32	Poland×Russia	884	.071	73	Ireland×Poland	30	.0024
33	Germany×Russia	815	.065	74	U. K.×Poland	28	.0022
34	Italy×other foreign	704	.056	75	Scandinavia×Poland	14	.0011
35	Germany×other foreign	638	.051	76	Hungary×Canada	12	.00096
36	Scandinavia×other foreign	597	.048	77	Hungary×Scandinavia	10	.0008
37	U. K.×Russia	560	.045	78	Hungary×Ireland	9	.0007
38	Canada×Ireland	552	.044				
39	U. K.×other foreign	463	.037				
40	Hungary×Russia	453	.036				
41	Hungary×Germany	397	.032				
					Total	1,253,848	100.004

Copied without recalculation from pp. 621–622.

"From Table V it is seen that 65 per cent of the children produced in the Birth Registration Area in 1919 were from American born parents while 10 per cent had one parent native born leaving approximately 25 per cent of the total births having both parents foreign born."

"From one point of view it will be regarded as alarming that but 65 per cent of the children born in this country have both parents native born. But, on the other hand, as the figures show, the proportion having both parents native born is overwhelmingly larger than that for any other mating."

It is apparent also that of all the foreign races just three groups amalgamate with native stock more frequently than with self. These groups are Canada; England-Scotland-Wales; and Germany. Contrary to expectation the foreign-born Irish marry amongst themselves approximately three times as often as they marry any other race including natives.

The following table shows the extent to which foreign-born immigrants marry within their race as compared with the marriages they make with native stock. Marriages in this case meaning biologically effective matings.

	% Pure Bred	*% Crossed with native*
Austria	81.0	12.0
Hungary	88.0	7.7
Canada	40.0	54.7
Denmark-Norway-Sweden	51.7	43.0
England-Scotland-Wales	33.3	52.5
Ireland	72.5	22.8
Germany	33.2	55.0
Italy	85.0	13.0
Poland	82.0	13.0
Russia	78.0	12.0

From this table it is seen that the race which fuses most readily with the native stock is the German while curiously enough only 22.8 per cent of the Irish amalgamate with native-born stock.

Not content with having exposed the fallacy of the general belief that immigrants do not amalgamate with the native stock Dr. Pearl disposes also of that other general opinion that the new arrivals would be better off on the farm.

"The native population has a *lower* vital index [100 births÷deaths] in the cities than in rural districts; the foreign population shows the reverse relation, the higher index being for city populations." "By and large, and with all factors included, as they are in the vital index, it appears that the foreign population, as it is actually constituted in the Birth Registration Area in respect of age, etc., is a biologically fitter population in the cities than is the native; while the native population is better under rural conditions."

From the standpoint of the negro problem the following conclusions are of interest: "Indeed one may say generally that, except in the rural districts of the southern states, practically never does the vital index of the negro populations rise to a value of as much as 100. But plainly enough any population with a vital index under 100 is a dying population. Such a population is bound, in the fullness of time, to disappear completely, if nothing whatever is done about the case. Nowhere in cities, even in the southern cities, does the value of the negro vital index get to 100 in a fairly normal year such as 1917."

"Even in rural portions of the Birth Registration Area the negro index does not approach in magnitude the total white index nor the native white index for the same communities. This is true in southern states as well as in northern. It would be difficult to find a more complete and critical demonstration than that furnished by these indices of the fact that the negro is biologically a less fit animal, *in the American environment physical, social and general than the white.* Under conditions *as they are,* Nature, by the slow but dreadfully sure processes of biological evolution, is apparently solving the negro problem in the United States, in a manner which, when finished, will be like all of Nature's solutions, final, complete and absolutely definite."

The solution of the population problem is believed to lie in a policy of periodic immigration. "From the standpoint of quality of the population in respect

of health, intelligence, and all round efficiency, it is suggested that the wisest policy from now on for the country to pursue would be one which might be called intermittent or periodic immigration. Let all immigration of any sort whatever be rigidly and completely prohibited for a period of say 20 years, to be followed by a period of say 10 years of free immigration, with only such restrictions physical, economic and criminal, as we have in the immediate past imposed During the period of no immigration the foreigners of the last influx and their children would become sensibly assimilated and fused into the American population. For the most part, they would have become Americans in a real sense of the word. Such a plan would further provide for that periodic inflow of new blood, of low living standaıds, which seems to be, both an economic and social necessity at least to civilizations which are still in the stage of industrial development and exploitation. Finally such a plan would, so far as one can foresee, postpone the period of pressing over-population as long as it can humanly be postponed, without the necessity of resorting to internal interferences of dubious practicability."

Although this analysis shows clearly that the foreign immigrant is fusing rapidly with the native stock—a condition deplored by most geneticists as one certain to dilute and degrade the races to which much of our present civilization is attributed Dr. Pearl again assumes the contrary position. Summing up the results of the vast experiment in human genetics which has gone on for three centuries in the United States he says: "When I compare the net result, as indicated by the human product now here—the product counted in the 1920 census—with the more nearly pure-bred peoples of Europe, I cannot force myself to that pessimistic outlook that I am told by some of my '100 per cent, Nordic' friends that I ought to. It seems to me, looking at the matter as a biologist, that a real, distinct, unique *American* people has evolved in the course of the experiment and is still continuing to evolve. Further, as people go, it is not a bad people. Its most interesting and valuable feature is that it is still changing and evolving. I can find no manner of bitter feeling or even regret that the pure English-Scotch-Welsh stock of the original settlers will eventually not be the dominant element in the complex of American germ-plasms that it has been in the past, though personally I am wholly of that stock, and am, for three centuries, an American. Such a state of affairs was, in the natural course of events, bound to come about. There cannot, by any possibility whatever, be anything approaching biologically pure race stocks in this country a century hence. There are practically none now, with the exception of the Jews, and there is every present reason to believe that even they will be far less pure in 2021 than they are in 1921."

"The kind of people who will survive and run the affairs of the country, say a couple of centuries hence, when population pressure will be intense, will, I think not be Englishmen, or Slavs, or Jews, or Italians, but *Americans*, of that type which has shown the greatest adaptability to the problems which life in this part of North America has presented. I think they will be just as gentle, as high-minded, as clever, as honorable, and as independent as any people on the face of the earth."

Most statistical treatises are shunned by the layman as being too dry and academic for any but statisticians but in shunning the present paper the reader will have missed an intensely interesting and intelligible analysis, for Pearl has conjured up a picture of racial conditions as they now exist in America that, even though the conclusion be accepted with reservations, furnishes a graphic base from which to peer into the future and in the hackneyed phrase of the book reviewers, "is nothing if not thought provoking."—*J. H. Kempton, Washington, D. C.*

MICROCEPHALIC PEOPLE SOMETIMES CALLED "PIN HEADS"

One of the most striking forms of congenital abnormalities is Microcephalus, characterized by small brain, weak nervous system, and low grade muscular co-ordination

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MICROCEPHALY in the human species is variously described as a condition in which the cranium and the cranial content capacity is so small as compared with the normal or average that there is not space for lodgment therein of a sufficiently large brain to direct, guide, and control human function in a normal way.

It is generally accepted that a human adult cranium measuring below 17 inches in circumference is markedly miscrocephalic, and anything below 19 inches is too small to contain therein a full sized or normal and complete functioning organ.

However, it is not alone the cranium or skull which is disproportioned, for casual observation shows that there are other physical abnormalities present in these cases, such as small stature, drooping shoulders, apparently long extremities, as legs and arms, loose joints, partially flexed knees when standing, and weak nervous system as well as weak minds, as revealed through lack of vim, early fatigue, low grade of muscular co-ordination, silly actions and expression; however, they are usually good, simple mimics, shy and cunning, able only to articulate a few indistinct monosyllable words. These individuals are often described or spoken of in a popular way as pin-headed, anthropoid, simian, theroid, pithecoid, atavistic, foxy, apish, mimics etc.

When we come to apply these various descriptive terms to individual cases we are at once struck with their apparent aptitude thereto; however, further analysis often proves some of these terms less scientifically accurate as, for instance, anthropoid or simian as indicating that when the individual stands erect the tip of the middle finger of the hand falls,—when the arm and fingers are extended and allowed to fall to the side of the standing individual,—too far down the thigh toward the knee as compared with a normal human being, whereas when the microcephalic is grasped by the two shoulders from behind and the collar bones and shoulder blades drawn back and the spine made wholly erect, the tips of the fingers assume nearly if not an entirely normal position with reference to the knee, thus showing that it is more a laxity of tissue and absence of nervous and mental vim and control than an abnormal bone or skeletal structure that is at fault in accounting for this symptom.

Atavistic, as applied to these individuals, assumes that herein is shown a tendency to retrovert to an ancestral type, supposing that in these families, or at least these individual cases, there is a devolutionary process going on for at least one generation, and that there is a hereditary tendency to strike back to a primitive type of man. It occurs about twice as often in males as females, and often more than one child in the same family, although so far as we can find, seldom in succeeding or intermitting generations of the same family as the following history corroborates.

Dr. Shuttleworth says "of congenital abnormalities the most striking is *microcephalus*. In its extreme form it is characteristic of a low form of idiocy, in which have been traced simian and even theroid resemblances. There are a series of gradations rising

through idiocy and imbecility to simple 'feeble-mindedness,' which is not infrequently associated with small-headedness. Microcephalus, however, does not depend solely upon diminutive size of head, as ascertained by measurement; and in our opinion the limitation of the term proposed by some to cases in which cranial circumference does not exceed seventeen inches, is scarcely scientific. There is a characteristic form, as well as size, of microcephalus heads; such, for example, as a narrow, rapid receding forehead, a somewhat pointed vertex, and a flat occiput. Though of course the frontal and parietal lobes are on a small scale, it is in the occipital and temporosphenoidal that we usually find the most striking evidence of arrest in development. A remarkable case ('Freddy'), for twenty years under the authors observation at Lancaster, was anatomically reviewed by Dr. Telford Smith and Professor Cunningham, of Dublin. His brain weighed only 12½ ounces; the convolutions were simple, though fairly distinguishable in the anterior lobes, but became rudimentary posteriorly, the occipital and temporosphenoidal lobes being indeed very imperfectly developed. This 'Aztec' like youth, who had large bright eyes, an aquiline nose, and somewhat receding chin, manifested good powers of observation, but was only able to express himself in a few monosyllabic words. He had considerable will power, and though it was found impossible to train him to much that was useful, he was in no sense a low-grade idiot. We have repeatedly seen boys and girls with heads measuring only nineteen inches, taught to read and write, and to do industrial work. Quality of brain is an important factor, as well as quantity, and in cases of microcephalus what little there is is usually fairly active."

There were five of these children—four boys and one girl—among a family of ten children variously interspersed as regards age.

These three boys' heads measured in in circumference 15″, 15½″ and 16″. They were all three able to dress and make their own toilet, and two of them learned to assist in dining room work, washing dishes and setting tables, and knew the difference between eight or ten plates on the table and the corresponding number of forks, spoons, and knives for a like number of places. They knew this not from counting—they were unable to count—but from relative position and habit of repetition.

Many cases have come to our attention where operation (craniectomy) had been done on the skulls of these individuals, hoping thereby to allow the cranium to expand and the brain to grow and develop, it being assumed that the sutures and fontanels had ossified and closed too early in life and thus confined and prevented the brain from normal growth. The results of these operations were never successful or promising and no experienced surgeon does the operation these days.

Many times as a result of pressure on the brain from scar tissue resulting from the operation, convulsion and paralysis ensue.

Due credit is to be given Miss Marjorie Fulstow for collecting this family record as follows:

FAMILY HISTORY OF THE PIN BOYS

The representatives of this family in the Rome School are August P. (IV, 13), Charles P. (IV, 14), and Raymond P. (IV, 17), all microcephalics of a pronounced type. The record states that August P. was born in New York State in 1888, and that he cannot read or write or learn anything; is clean in his personal habits, can speak a few monosyllables indistinctly and tries to tell his name. He was brought here from the School at Syracuse. When admitted to the R. S. C. in 1905, he tested three years mentally. He is employed in the patients' dining-room and is seldom disturbed; he was once known to strike an attendant.

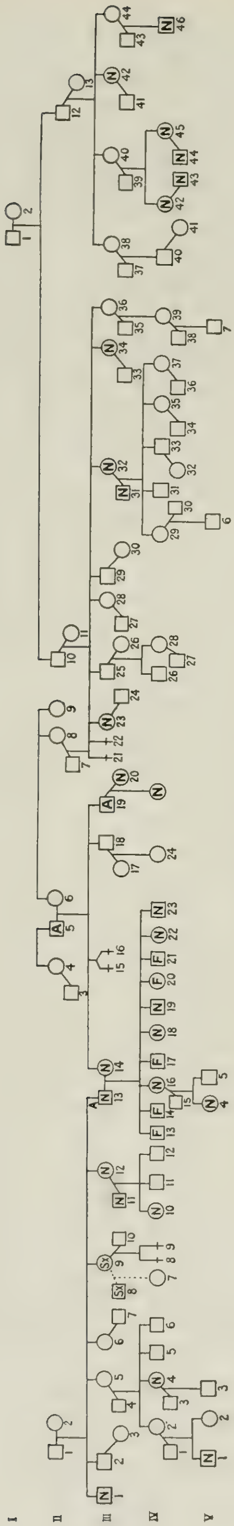
Charles P. (IV, 14) was born in New York State in 1890, a microcephalic. In 1903 he tested four years mentally, while in 1914 he tested three years. He also was transferred from the Syracuse school to this institution.

THREE HAPPY PIN BROTHERS

The form, as well as the size of the microcephalic head is characteristic, and abnormalities of other parts of the body frequently accompany the condition. There are cases on record of microcephalic brains weighing only eight ounces, while the weight of the average male brain is 48 ounces. Quality is more important than quantity, but it is not considered possible to attain normal mental development with a brain weighing less than 32 ounces. (Fig. 17.)

PROFILE VIEW OF THE SAME THREE PIN BROTHERS

Some Microcephalics learn to read and write, but these three boys never could be taught to count. Two of them had a mental age of three, the other of four years. On the theory that the condition is caused by too early ossification of the sutures and fontanels, operations have been attempted to enlarge the cranial cavity, but they never resulted in any increased development of the brain. (Fig. 18.)



THE PIN FAMILY TREE Fig. 19.

Raymond P. (IV, 17) was born in New York State in 1894. His understanding of language is very slight hearing apparently normal. He was admitted from the Syracuse school in 1910. In 1913 he tested three years mentally; he is now 21 years old and tests four years. He is very stupid and requires a great deal of attention; was employed a short time in the patients' dining-room, but later was of no use there because of his untidy personal habits.

PATIENT'S FRATERNITY

Mary P. (IV, 16) was born in New York State in 1892. She is quite a nice looking woman of medium height, fairly reserved, and courteous and shows evidence of a good bringing up; appears to be practical and to have very good sense, and is an intelligent woman. She is married to Mr. R. (IV, 15) who is a foreman in a factory. They live in the upper story of a house and the rooms, though small and few in number, are clean and well kept. They have two children, aged two years. and six weeks, respectively, both whom are attractive children; the older one, Irene acts decidedly like a normal child. The younger one who was asleep when I called does not appear to be abnormal in any way.

Grace P. (IV, 18) was born in New York State in 1895, is a pretty, well formed, intelligent and capable girl. She is the only member of the family who is working at the present time. She has earned her living as a housemaid, but is now (1921) a stenographer.

Warren P. (IV, 19) was born in New York Sate, 1897, is six feet tall, well formed and athletic. He has a grade achool education and is now a good carpenter, according to his father.

Wilhelmina P. (IV, 20) was born in New York State in 1899, and, like her brothers, is a pronounced microcephalic She is clean in her personal appearance, but it is not known whether this is due to her own efforts or to those of her mother. She is cross-eyed and one eye is very bad looking; it is not known whether she can see out of it or not. She has a very bad temper and is

becoming more troublesome and harder to control as she grows older. She was sent to the Newark State School in 1921.

Walter P. (IV, 21), born in New York State in 1901, was admitted to the Rome school in 1921 and later died. He was also a pronounced microcephalic like his three brothers at this institution. He was of a much better disposition then his sister (IV, 20) and much easier to manage for that reason. He was very tractable until crossed or thwarted in any desire; had a little understanding of language and could talk a little.

Gertrude P. (IV, 22), born in New York State in 1904, has a grade school education, is studious, bright and pretty.

Earl P. (IV, 23), born in 1907, is an unusually bright and attractive boy, but skips grades at school.

PATIENTS' FATHER

August P. (III, 13) was born in New York State in 1862; has lived most of his life in New York State. He has unusually good health, has had no operations and the only diseases he has had are the ordinary infectious diseases of childhood. He is a large, fine looking man, erect and intelligent, appears to have fairly good sense but has been very intemperate, though his brother, William P., says that he is doing much better now. He is not related to his wife. His occupation at all times has been that of a carpenter. Although Dr. L. did not notice anything peculiar about his head I have heard from two sources that it slopes back quite abruptly from his eyebrows. They say that he is a fine looking man until he takes off his hat. Some of their friends think that this is a curse put upon the family because Mr. P. was engaged to marry another young woman and then fell in love with and married Mary S.

FATHER'S FRATERNITY

Fred P. (III, 2), born in Germany, is described by his relatives as being all right physically and mentally. He is married and lives in Canada. A letter from his daughter shows her to be intelligent and fairly well educated.

William P. (III, 1), born in Germany, is a very pleasant and courteous man, has a common school education, kept a saloon in the foreign section of a city, but has no appearance of intemperance, and is an intelligent man. Like the rest of the Pin family he has heard that far back in the history of the mother's family there have been reports of peculiar children. This rumor, however, seems to be unfounded; nothing definite is known about it, and it seems to be something invented by the Pins to account for the children of August P.

Christina P. (III, 5), born in New York State, has no education to speak of, and talks with a decided German accent. She lives with her husband, Mr. S., in a well built and comfortable house in section of the city where the more prosperous of the working class live. She is about as intelligent as the average uneducated German women. Like the rest of the Pins she thinks that if there is a heredity cause for the children of August P. it is on the mother's side.

CHILDREN OF III, 5 & 4

Ada S. (IV, 4) is a neat, clean, industrious and bright young woman. She went through the ninth grade at school and intended to finish school but failed in one subject and became discouraged and quit. She married Mr. G. (IV, 3) and they have an eight month old baby, seemingly normal. They live in a house of average size which looks well kept.

Bertha S. (IV, 2) has a grade school education, is married and lives near her mother. She has two very attractive children, a boy of five and a girl younger.

John S. (IV, 5), finished the ninth grade at school. He is now working for an insurance company and is self supporting. He is unmarried and in appearance is tall and slim.

Fred S. (IV, 6) is still in school, now about the first year of high school.

Katie P. (III, 6) married Mr. K. She is described by her sisters and the relative of Mrs. P. as being all right mentally and physically.

Mary P. (III, 9) is described as being very peculiar looking. She is very dark with eyes close together and very black hair which grew far down on her forehead. She had a peculiar way of looking at people out from under her bushy eyebrows. She had an illegitimate daughter, then married a Mr. N. (III, 10) and had two children who died in youth, one of diphtheria and the other of convulsions while teething. III, 5 says that there was nothing wrong with any of these children.

Anna P. (III, 12), who is the youngest of the family, was born in New York State. She is a very well built, healthy appearing woman. She has a better education than her sister (III, 5), is intelligent, makes a good appearance and is decidedly normal. She married Mr. E. (III, 11), who has a plumbing establishment in the down-town section of the city. They live in a very good section of the city in a nice, newly built house which has an air of refinement about it.

CHILDREN OF III, 12 & 11

Edna E. (IV, 10), born in New York State in 1897, is now attending the high school in her home city.

William E. (IV, 11), born in New York State in 1901, is also at school where he is reported to be getting along nicely.

Robert E. (IV, 12), born in 1905, is also in achool; reported to be bright.

FATHER'S FATHER

Fred P. (II, 1), born in Germany, had a common school education; principal residences Germany and New York State; married when quite young. While in Germany his occupation was that of a soldier; he was wounded in the war of 1870. In America he was a saloonkeeper. He had no grave illness that his son knew of; died at 75 years of age. He was not related to his wife. As the Pins are people who do not know much about their family it is impossible to find out anything about them farther back than this generation.

FATHER'S MOTHER

Wilhelmina V. (II, 2), born in Germany, died in New York State at 72 years of age (kidney trouble). She was noted for her great strength and ambition. The family tell an anecdote of how this woman during the war of 1870 picked up two soldiers one after the other who were making themselves a nuisance around the place and threw them over a manure pile.

PATIENT'S MOTHER

Mary S. (III, 14), born in New York State in 1866, had a common school education; principal residences in New York State; married August P. (III, 13) in 1887; was a house-maid until her marriage. She had the ordinary children's diseases but otherwise was not sick a day in her life except when her children were born. she is a good house-wife, keeps all the children tidy and is kind to the defectives. She has an unusual amount of intelligence for an uneducated German woman, and is very clean in appearance. Dr. L. was very much impressed with her as a woman of unusual patience and wonderful in managing the children and keeping the household together. She is decidedly a woman of normal mental ability, and is faithful to her husband and family. After the three were put in institutions, her brother, Frank S., offered to take her and her children and give them a good home if she would leave her husband, but this she refused to do and is still living in very poor circumstances when she might be living in luxury. The family live in a very poor house where all the houses look run-down and poorly kept. No one could make Mrs. P. admit that there was anything wrong with the three oldest children for a long time. She would always say that they were as bright as any of the children, and it was not until August (IV, 13) attempted to put his mother in the oven of the kitchen stove that she would have the microcephalics put in institutions.

MOTHER'S FRATERNITY

Charles S. (III, 18), born in New York State in 1860, moved to the West sometime ago and has lived there ever since. I have communicated with him

and he says that he does not know of any other cases of feeblemindedness in the family. He is self supporting and according to his sister (the patients' mother) has a normal daughter ten years of age.

Frank S. (III, 19), was born in New York State in 1864; has not much education; married Louise W. a woman of good business ability. He kept a saloon and has made a great deal of money, not due to his long sightedness, however, except in the matter of economy, but to the business ability of his wife. He has been described as still possessing in some form or other "the first nickel he ever earned." He was described as being a mutton-head and after meeting him I was convinced that he merited the description. The S. family live with their one bright appearing daughter in one of the finest residence sections of the city, where they have built a house which is almost palatial. Their money evidently hires their taste, for everything in the house is in keeping with the exterior. Although they posses this fine house, they spent much of their time in their business place. Dr. L. visited the house on four different days and found no one at home; the fifth time, however, was on a Sunday morning and we succeeded in gaining admission after ringing the bell a long time.

One can tell from the appearance of Mr. S. that he is very intemperate. He is the opposite of his siter in the matter of patience, and is out of patience with her at the present time upon that very subject.

There were a pair of twins (III, 15 & 16), who died in infancy. From three sources we have it that the twins were all right physically and mentally, and that they died of cholera infantum when they were about two and four weeks of age respectively.

MOTHER'S FATHER

Jacob S. (II, 5), was born in Germany; supposed to have had a common school education; lived the greater part of his life in New York State where he was the proprietor of a saloon for many years; was a thrifty business man; had no grave illness nor operations; was very intemperate especially after the death of his wife. He died at the age of 56 years.

MOTHER'S FATHER'S FRATERNITY

Elizabeth S. (II, 4), married Mr. T. and lived for many years in Ohio. Relatives of Mrs. P.'s mother say that the family are bright people as far back as they know.

MOTHER'S MOTHER

Adeline K. (II, 6) was born in Pennsylvania and died at the age of 44 years in child-birth when the twins were born. No cases of feeblemindedness in the family.

MOTHER'S MOTHER'S FRATERNITY

Harriet K. (II, 8), married Mr. W. and had two children who, according to some stories, were eyeless, and, according to others, had eyes but could not see, while others state that the eyes of these children were not in the right place. The mother herself (II, 8) is described as an intelligent woman with no peculiarities of mind or body.

Mary Anne K. (II, 9), unmarried, is a keen old lady. She was present at the birth of the oldest Pin boy and said to the doctor as soon as she saw him "that child is not right," but the doctor ridiculed the idea as pure imagination.

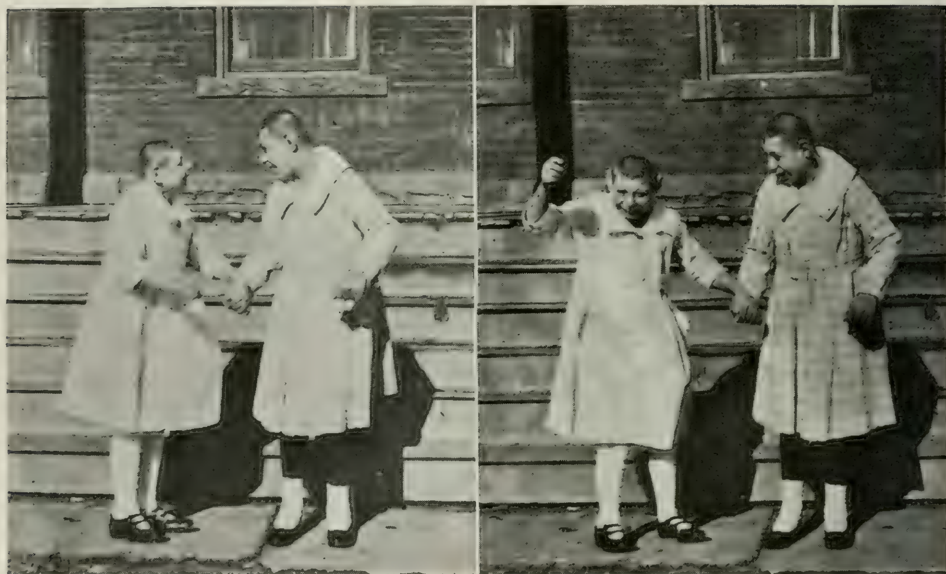
Jacob K. (II, 10), as far as I can find out, was of good mental ability. He had no microcephalic tendencies; his daughter says that although he is a large man his head was unusually large and he usually had to have his hats made to order. He was married and his children are as follows:

Rose K. (III, 23), married Mr. T.; has no children. She is a pleasant and intelligent woman of about 70 years of age and lives with her sister (III, 32).

John K. (III, 25) is a good business man. He is married and has a son who is a lawyer, and a daughter who is married and lives in New Jersey.

Lavina K. (III, 28), married Geo. B.; had no children; died of heart trouble.

George K. (III, 29) was a painter



TWO MICROCEPHALIC GIRLS—NOT RELATED TO EACH OTHER OR TO THE PIN FAMILY

Microcephaly occurs about twice as often in men as in women. There is generally more than one case in a family, although all the children are not microcephalic. Apparently there was no hereditary cause for the cases recorded in this article. (Fig. 20.)

who lived in Ohio; died at the age of about 60 years as the result of lead poisoning.

Sarah K. (III, 32) married Peter H. (III, 31) and lives in a small cottage. The house and grounds are neatly kept and although it is a modest dwelling, there is no evidence of shiftlessness there. Mrs. H. is an intelligent and refined woman who is interesting to talk to; she seems to be honest and thoroughly respectable, and has a fairly good education.

CHILDREN OF III, 31 & 32

Lillian H. (IV, 29) married Mr. S. and lives in Canada with their one son. I was shown a photograph of the three and they all appear to be of at least average mental ability.

Charles H. (IV, 31), a painter, unmarried, lives at the home of his parents. He was away at work when I called. His mother says he is of good mental ability.

George H. (IV, 33) is married but has no children. He was a saloon keeper in New York State; he and his wife lived over the saloon which was in the residence district of the city.

Sarah H. (IV, 35) lives in Ohio with her husband who is at the head of a bond department of a large bank, according to Mrs. H. (III, 32).

Olive H. (IV, 37) married a man who is an upholsterer. They live at the home of III, 37 who is a widow.

Adaline K. (III, 37) married Mr. E., who died several years ago leaving little property. Mrs. E. keeps a small grocery store, at the rear of which she lives with her niece and nephew; she is a lady in every sense of the word and uses the best of language in conversation. Her rooms, though small, show evidence of good taste. She says that they have often discussed the Pin children and wondered what the cause was, but did not know of anything in the family that might possibly account for their peculiarity. She impressed both Dr. L. and myself with her apparent reliability and honesty.

Alice K. (III, 36) married a brother

of III, 31, and lives in New York State where they own and manage a peach farm. She has one daughter who is now married and has a bright son.

John K. (II, 12) came to New York State with his parents from Pennsylvania on horseback. He has been dead several years; is reported to have been bright; was married and had children some of whom married into very good families:

Mary K. (III, 38) married a physician and lived in the west; they had a son who is now a physician and who married a normal woman who was a nurse in a hospital.

Martha K. (III, 40) married Mr. S.; had two daughters, one of whom married a leading florist, and the other married a former attorney general of New York.

Another daughter (III, 42) of John K. married a lawyer.

Another daughter (III, 44) married Mr. L. and they have a son who is a physician.

MOTHER'S MOTHER'S FATHER

K. — (I, 1) a Pennsylvania dutchman from Reading, came to New York State on horseback, accompanied by his entire family. He was a blacksmith; died at the age of over 70 of bloody dysentery.

MOTHER'S MOTHER'S MOTHER

Sarah R. (I, 2) came originally from England; married I, 1 in Pennsylvania; died of cancer at the age of seventy-eight.

SUMMARY

In this family we found five of the ten children microcephalics of a pronounced type when the father and mother were both of good physical type and mental ability, and the only family factor reflecting degeneracy, so far as we can find out, is alcholism.

Present Status of the Journal of Heredity

The Council is much gratified to be able to announce a grant from the National Geographic Society to the American Genetic Association which will make it possible to issue the deferred numbers as rapidly as the printer can handle the material.

The grant received from the National Geographic Society was in accordance with the following resolution adopted by the Research Committee of that Society on January 20, 1922:

"The National Geographic Society hereby makes a grant of three thousand dollars to the American Genetic Association for the encouragement of research in genetics in relation to geography, the fund to be used for the publication of illustrations that constitute a record of the research work of plant and animal breeders."

This timely act of the National Geographic Society in support of research in genetics will insure the regular publication of the JOURNAL. It is earnestly hoped that by the end of the year the membership can be increased sufficiently to make the JOURNAL self-sustaining. All members of the Association are urged to use their best endeavors in adding to the membership. It is believed that with 5000 members *in good standing* the JOURNAL could be published without other financial assistance. This membership increase should be made without delay in order that there shall be no set-back in publication again this year.

The membership of the American Genetic Association has increased steadily in recent years, but the revenue from membership dues has never been sufficient to pay the entire cost of publication of the JOURNAL, the deficit having been made up each year by a few members who have contributed generously for this purpose. It was hoped that when the membership should reach its present figure of 3625 the JOURNAL would become self-sustaining, but the continued high cost of printing resulted in such a serious deficit in the latter part of 1921 that it was impossible to continue the issue of monthly numbers as they became due.

ORIGIN OF FALSE WILD OATS[1]

R. J. Garber

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THE occurrence of false wild oats in cultivated varieties of *Avena sativa* and *A. orientalis* has been observed by several plant breeders. The question of their origin is one which has given rise to rather spirited discussions. Nilsson-Ehle (1911) contends that false wild oats are due to a loss mutation whereas Tschermak (1914) and Zade (1918) contend that they are the result of natural crossing. Zade's views are summarized in his monograph, Der Hafer, pages 217 to 225 inclusive.

During the summer of 1920 false wild oats were observed in a number of different pure lines of oats growing on University Farm, at St. Paul, Minnesota. The lines in which false wild oats appeared were carefully examined, and a collection of individual plants with different phenotypes was made. In this paper only the false wild oats which appeared in the varieties Victory, Garton 784, and Aurora are discussed. The material which was collected at University Farm[2] was grown during the summer of 1921 in the plant breeding nursery at Morgantown, West Virginia.

As Nilsson-Ehle has pointed out, false wild oats differ from the cultivated varieties in which they appear in awn development, articulation of both the upper and lower seeds, and in the amount of pubescence around the articulation. Homozygous false wild oats bear heavy geniculate awns and have distinct fatua-like articulations surrounded by dense tufts of hair on both the upper and lower seeds. In general, heterozygous false wild oats bear heavy geniculate awns on the lower seeds only. On the lower seeds the articulations and the amount of hair around them are intermediate between these same characters in the homozygous false wild and cultivated forms. The upper seeds of heterozygous false wild oats are very similar to the upper seeds of cultivated oats.

VICTORY[3]

In 1918 a number of panicle selections were made from Victory oats at University Farm. In 1920 one of the plant rows which represented the progeny of a single panicle was found to contain false wild oats. The homozygous and heterozygous false wild Victory plants were easily distinguished from one another as well as from the true Victory plants. All forms had white seed and open panicles but the three different groups were clearly separated in respect to awn development, articulation of the seeds, and pubescence around the articulation. Seed of individual plants of each of the three categories was grown separately in 1921. From Table 1 the character of the parent plant and the nature of its progeny may be determined. All the plants produced white seed. Homozygous false wild Victory and Victory plants bred true whereas the heterozygous false wild Victory plants produced progeny which again segregated into sativa-like, heterozygous, and homozygous false wild forms. The 15 individual plant rows coming from seed of heterozygous plants produced a total of

[1] Contribution from the Department of Agronomy, West Virginia Agricultural Experiment Station, Morgantown. Published with the approval of the Director.

[2] The writer is indebted to Dr. H. K. Hayes for permission to transfer the seed which produced the plants reported below from the Minnesota to the West Virginia Agricultural Experiment Station.

[3] The writer is indebted to A. Berg, Assistant Plant Pathologist, for the photographs; and to T. E. Odland, Assistant Professor of Agronomy, and K. S. Quisenberry, Instructor in Agronomy, for their aid in collecting the data.

OAT PANICLE TYPES

The normal panicle of the variety Victory is on the left (awns on lower kernels only), and in the center is the heterozygous false wild (only lower kernels of spikelets awned), and on the right the homozygous false wild (usually heavy, geniculate awns on both kernels in a spikelet). Apparently the false wild oats are true mutations and not crosses with wild oats because the segregation of the progeny of the false wild forms is very different from that of actual crosses. (Fig. 21.)

TABLE I: *Data showing the nature of the progenies from individual plants of Victory oats, heterozygous false Victory, and homozygous false Victory; all the progeny of a single plant*

Parent Class	Row number	Number of plants			Parent Class	Row number	Number of plants		
		Victory	Het. f. Vic.	Homo. f. Vic.			Victory	Het. f. Vic.	Homo. f. Vic
Victory	1S	16			Het. false Vic.	14S	4	13	3
"	2S	20			" " "	15S	4	11	6
"	3S	19			" " "	16S	4	10	7
"	4S	18			" " "	17S	1	18	3
"	5S	19			" " "	18S	3	8	8
Homo. false Vic.	6S			20	" " "	19S	2	11	6
"	7S			17	" " "	20S	7	7	6
"	8S			19	" " "	21S	2	12	2
"	9S			16	" " "	22S	6	9	5
"	10S			16	" " "	23S	4	11	4
Het. false Vic.	11S	4	11	6	" " "	24S	3	10	6
" " "	12S	4	12	6	" " "	25S	3	9	5
" " "	13S	3	11	7	Total Het. f. Vic.		54	163	80
					Expectation (1:2:1) P=0.0256		74.25	148.50	74.25

NORMAL PANICLE AND FALSE WILD FORMS OF THE CARTON 784 VARIETY OF OATS

It is not hard to distinguish the three types, the homozygous false wild form on the left, the heterozygous false wild in the center, and the Garton 784 on the right. Heterozygous false wild oats are intermediate between the other forms. They do not breed true to type, whereas the other two forms do, and their progeny segregate into sativa-like, heterozygous false wild oats, and homozygous false wild oats. (Fig. 22.)

54 Victory, 163 heterozygous false Victory, and 80 homozygous false Victory plants. This ratio does not agree very closely with monohybrid expectation ($P=0.0256$). In only three out of one hundred trials would divergencies as great as this be expected solely due to chance.

GARTON 784

False wild oats were also observed growing in a pure-line selection of Garton 784 made at the Minnesota University Farm, in 1915. Here, as in Victory, it was easy to distinguish the three categories of plants on the basis of awn development, pubescence, and articulation. On the other hand, the homozygous and heterozygous false wild oats as well as the true Garton 784 had black seeds and side panicles but were non-liguled forms. The parent plants classed as homozygous false wild Garton 784 and homozygous Garton 784 bred true to these types respectively. The 16 parent plants classed as heterozygous false wild Garton 784 produced a total of 81 Garton 784, 122 heterozygous false wild Garton 784, and 55 homozygous false wild Garton 784 ($P=0.0498$). Here again theory does not agree very well with observation. The segregation, however, is similar to that obtained from the heterozygous false Victory plants. Considering both varieties together there were 135 cultivated, 285 heterozygous false, and 135 homozygous false forms. This is obviously a 1:2:1 ratio ($X^2=0.4053$; $P=$ close fit). Nilsson-Ehle (1911) and others obtained similar segregation.

AURORA

Aurora is a pure line selection made by Mr. C. W. Warburton of the United States Department of Agriculture. It has a short plump yellow seed and is

early in maturing. The sample grown at University Farm was obtained from the Kansas Agricultural Experiment Station. Two plants of homozygous false wild Aurora were found in the Aurora variety. A careful search in the rod rows did not reveal a single apparently heterozygous plant. The two homozygous false wild Aurora plants bred true. However, one of the 19 plants selected as pure Aurora gave progeny which segregated into 6 homozygous false wild Aurora and 13 which were apparently Aurora. It is possible that the phenotypes of homozygous Aurora and heterozygous false wild Aurora are very similar. More evidence is needed to clear up this point. As in Victory and Garton No. 784, the false wild Aurora seed has the same characteristics as the variety in which it appeared except in awn development, articulation, and pubescence. (See Figures 21 and 23.)

F_2 GENERATIONS OF CERTAIN OAT CROSSES

In connection with the consideration of the origin of false wild oats, certain F_2 generations of fatua-sativa and fatua-orientalis crosses are of interest. The crosses mentioned below and the plants reported above were grown in the same nursery and the same year at Morgantown.

The F_2 generation of a cross between a brown, hairy wild oat and Victory showed unmistakable evidence of segregation with respect to panicle type; size, shape, and color of seed; and amount of hair on the lemma as well as around the seed articulation. The segregation with respect to the character of the articulation was approximately one fatua to three non-fatua types as has been observed by others (Zade, 1912; Surface, 1916). Differences in panicle type were also obtained in the F_2 generation. The panicle of the brown, hairy wild parent is much longer, and has longer branches than the panicle of Victory. In the F_2 generation of another cross, Victory with a yellow wild oat, distinct segregation occurred with regard to the same characters mentioned above except pubescence on the lemma. The yellow wild parent used in this cross has hair only around the articulation and not on the other regions of the lemma. (See Figure 23.)

The same wild parents were crossed reciprocally with Garton 748, a variety similar to Garton 784 except in awn development and length of rachilla on the lower seed. False wild oats were found in the variety Garton 784. The F_2 generations of these crosses exhibited segregation similar to that noted in connection with the Victory-fatua crosses. In the Garton 748-fatua crosses, however, the difference in panicle type between the parents is more marked. Garton 748 is a side-panicled and non-liguled form. Figures 2 and 5 illustrate some of the F_2 segregates

TABLE II: *Data showing the segregation with respect to ligules in the F_2 generations of certain oat crosses*

Name	Culture number	Number of F_2 plants	
		With ligules	Without ligules
Garton 748 X Brown)	12–1	68	1
Hairy Wild Oats)	12–2	72	1
Reciprocal)	13–1	57	1
)	13–2	57	2
Garton 748 X Yellow)	8–1	75	0
Wild Oats)	8–2	61	2
Reciprocal)	9–1	62	1
)	9–2	58	2
Total		510	10

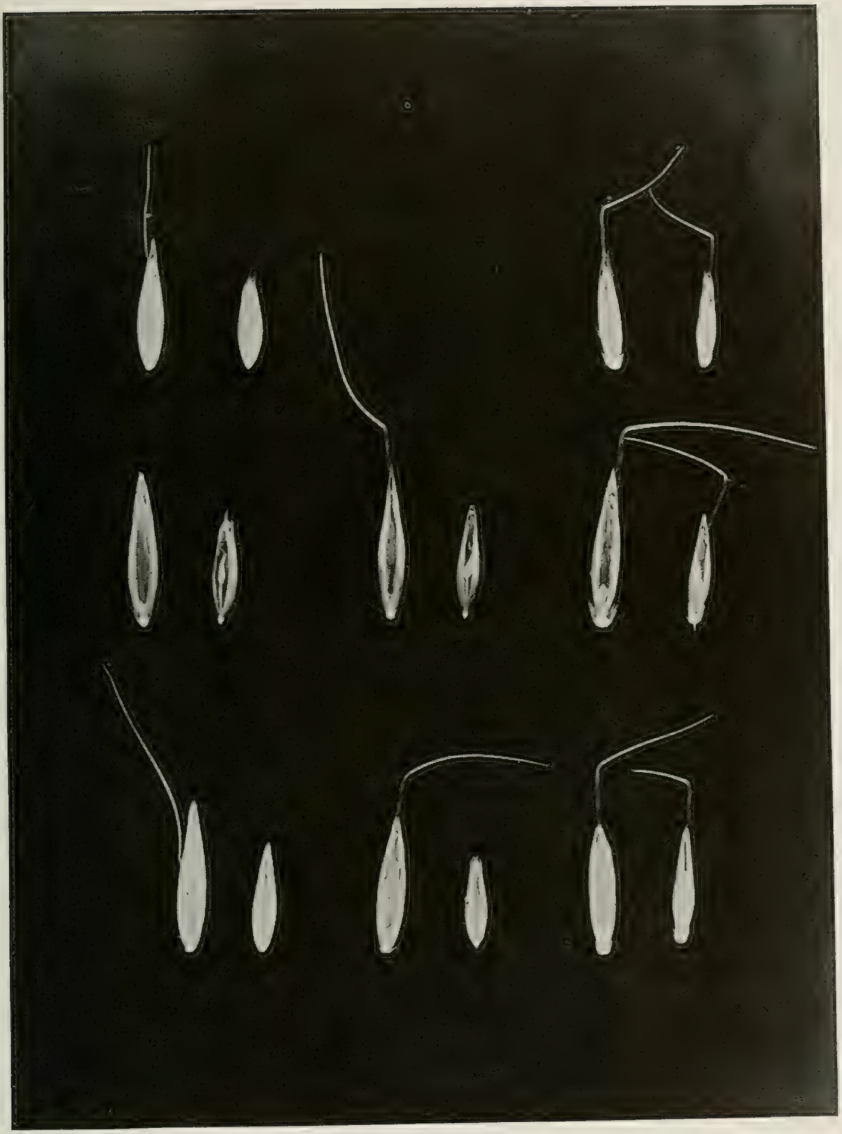
obtained. The segregation of the F_2 generations with respect to the presence or absence of a ligule is shown in Table II. In these crosses there are apparently three factor differences operating in the inheritance of the ligule character. In a total of 520 F_2 plants only 10 were without ligules. Assuming that three independently transmitted factors are involved, the presence of any one of which gives rise to a ligule, the deviation from the expected ratio is 1.0 times its probable error. In some other crosses (Nilsson-Ehle 1909; Love and Craig 1918) the presence or absence of a ligule apparently involves one, two, three, or even four factor differences.

THE F_2 AND F_3 GENERATIONS OF A VICTORY-GARTON 784 CROSS

The parents of the Victory-Garton 784 cross differ with respect to panicle type, seed color, and ligules. Segregation with respect to these characters appeared in the F_2 generation. Approximately three-fourths of the F_2 plants had black and one-fourth had white seeds. The segregation with respect to ligules was 489 with ligules to 38 without ligules. The 88 families of this cross which were grown in F_3 verified the F_2 segregation. Of these F_3 families, 36 bred true to the liguled condition; 20 segregated in the approximate ratio of 3 liguled to 1 non-liguled plant; 23 segregated in the approximate ratio of 15 liguled to 1 non-liguled plant; and 9 bred true to the non-liguled condition. The respective number of families expected in each category on a two-factor basis was 38.5, 22, 22, and 5.5 respectively. Theory and observation agree very well in this case, the value of P being 0.4609. Deviations as great as this, due solely to the errors of random sampling, would be expected in about one-half of the cases.

DISCUSSION

From the facts brought out above and an examination of the figures, it is obvious that the segregation observed in the F_2 generation of fatua-Victory crosses and fatua-Garton 748 crosses is very different from that among the progeny of heterozygous false wild oats. In the latter there is apparently but a single factor difference involved whereas in the fatua crosses there are undoubtedly several factor differences involved. Zade (1918) accounts for this difference by assuming that the natural cross between fatua and cultivated forms which gave rise to a particular false wild oat occurred many years previous ("Kreuzung jahrelang zurückliegt . . . . ") to the time when the false wild form was actually observed. If one accepts Zade's hypothesis as an explanation of the origin of the false wild oats reported in this paper one must account for the selective elimination of all phenotypes except the three types, cultivated, intermediate, and true false wild oats. In each case the intermediate and true false wild oats were apparently identical with the variety in which they were found except with respect to awn development, articulation of the seeds, and pubescence around the articulations. These three characters collectively depend on a single factor difference for their particular development in each of the three categories, homozygous cultivated, heterozygous false, and homozygous false forms. How may one account for the elimination of all the liguled plants which result from a cross between fatua and non-liguled orientalis forms or the elimination of all open-panicled plants? The white color of the false wild Victory seed and the yellow color of the false wild Aurora seed are other instances of recessive characters whose exclusive presence must be explained either on the basis of selective elimination or the possibility that the progeny of the particular fatua-sativa natural crosses showed no segregation with respect to color of seed. Similarly in the case of Garton 784 in which false wild oats were found the exclusive occurrence of black seeds could only be explained on the basis of selective elimination, or that in this case false wild oats ap-



COMPARISON OF THE SEEDS OF THREE VARIETIES OF OATS

The upper seeds of the oat spikelet differ from the lower. On the left are the lower and upper seeds from the spikelets of three varieties of oats (Aurora, Garton 784 and Victory). In the center column are the heterozygous false wild forms of two of these varieties and on the right are the homozygous false wild seeds. The upper seeds of the intermediate form are similar to the normal upper seeds, but the lower seeds resemble the homozygous form. (Fig. 23.)

peared because of a natural cross between a dark fatua and Garton 784.

In comparing the size and shape of seed of the three different phenotypes growing in rows segregating for false wild oats with the seed phenotypes of the F_2 generations of artificial fatua-sativa and fatua-orientalis crosses, (Figures 23 and 24) considerable differences are apparent. False wild Aurora seed is very similar in size and shape to the seed of true Aurora; a similar relation holds between the false wild and cultivated forms of Garton 784 and Victory respectively. In the F_2 generations of actual crosses between fatua and cultivated varieties it is clear that segregation occurred. Here again if one accepts natural crossing as the explanation of the origin of false wild oats, one must postulate that an elimination of phenotypes with respect to size and shape of seed has taken place or that the progeny of a natural cross between fatua and cultivated forms did not show segregation with respect to these seed characters.

Either of the two explanations is quite unlikely, particularly in the case of false wild Aurora. It is more probable that Nilsson-Ehle's hypothesis is correct, namely that the origin of false wild oats is the result of a mutation. The exclusive occurrence of monohybrid segregation among the progeny of heterozygous false wild oats is in itself evidence of a mutation. The single factor difference between the false wild oat and the respective variety in which it was found can most easily be explained as a mutation i.e., a change in the chromosomal locus which is concerned with the phenotypic expression of awn development, seed articulation, and pubescence around the articulation. It is true that monohybrid segregation also occurs with respect to character of seed articulation and certain closely associated characters in fatua-sativa and fatua-orientalis crosses but in addition there is segregation for characters not closely associated with the type of articulation. This is important evidence in connection with considering the origin of false wild oats.

Nilsson-Ehle points out one objection to Zade's hypothesis in explaining the origin of the false wild oats observed by the former. Fatua oats are not found in the vicinity of Svalöf. Zade found a positive correlation between the number of fatua forms and the number of "intermediate" (heterozygous false wild oats) forms present in any particular variety. Tschermak and Zade also suggest that natural crosses between cultivated varieties may explain the origin of false wild oats. This explanation is open to objections similar to the ones pointed out against accepting the hypothesis that false wild oats are due to natural crosses between fatua and cultivated oats. A satisfactory explanation other than a mutation for the exclusive occurrence of monohybrid segregation in the progeny of heterogygous false wild individuals has not been made. In the twelve pure lines, two commercial varieties and one F_2 generation of a cross (Glockenhafer II × Grossmogul) in which Nilsson-Ehle found false wild oats and in the three varieties of very different morphological aspect reported in this paper, the false wild oats and the respective variety in which they appeared differ only in awn development, articulation of the seed, and pubescence around the articulation. These three characters are conditioned by a single factor difference. Moreover, if natural crossing between cultivated forms is the cause of false wild oats it is rather singular that apparently they have not been observed or at least not reported more frequently by plant breeders who have made extensive studies in oat hybridization.

The false wild oats in Victory were discovered in the second generation of the progeny of a single plant selection. From[4] the time the plant selection was made until the false wild oats were discovered this particular strain was

[4] Information furnished by the courtesy of the Plant Breeding Section of the University of Minnesota.

LOWER AND UPPER SEEDS OF OAT SPIKELETS

These seeds represent the parents and selected plants from the second generation of an oat cross. In the top row are the seeds of the brown hairy Fatua (left) and Garton 748 (right). The other three rows show the paired seeds from twelve second generation segregates. (Fig. 24.)

grown in rows in close proximity only to other selections of Victory and the check (Improved Ligowa). The Garton 784 selection in which false wild oats were found, was made in 1915. The varieties or the pure line selections which were grown after the year 1916 in rows adjacent to this particular selection of Garton 784 were all white-seeded forms and most of them were

liguled. In 1916 the rows grown adjacent to this selection of Garton 784 consisted of other pure line selections of the same variety.

It was pointed out above that all homozygous and heterogygous false wild Garton 784 as well as cultivated Garton 784 had black seeds and the leaves were non-liguled. If false wild oats arose in this instance because of natural crossing between the Garton 784 selection and other cultivated forms, segregation with respect to seed color would be expected. Moreover, segregation with respect to the ligule character would also be expected provided the natural cross was between liguled and non-liguled forms.

Natural crossing occasionally occurs in oats as has been pointed out by Tschermak (1901), Fruwirth (1909), and Pridham (1916). A few years ago Professor A. C. Arny of University Farm, St. Paul, Minnesota, called the writer's attention to what apparently was a natural cross between a fatua and a sativa oat. The particular individual plant row showed segregation typical of an F_2 generation of a fatua-sativa cross. It is possible that once the mutation has occurred which produces false wild oats, their further dissemination is facilitated by natural crossing. There is also the possibility of confusing segregates of a fatua-sativa natural cross with false wild oats as described in this paper.

CONCLUSION

False wild oats were discovered in three very different varieties of cultivated oats namely, Victory, Garton 784, and Aurora. In view of the evidence presented the origin of these aberrant forms may be attributed more logically to mutations than to natural crossing.

Bibliography

Fruwith, C., 1909. Die Züchtung der landwirtschaftlichen Kulturpflanzen. Paul Parey, Berlin, Bd. IV, 2 Auflage, pp. 324–365.

Love, H. H. and Craig, W. T., 1918. Small grain investigations. *In* Jour. Heredity 9:67–76.

Nilsson-Ehle, H., 1909. Kreuzungsuntersuchungen an Hafer und Weizen. Lunds. Univ. Arsskr. N. F. Afd. 2, Bd. 5, Nr. 2, 122 pp.

————, 1911. Ueber Fälle spontanen Wegfallens eines Hemmungsfaktors beim Hafer. Zeitschr. für Induk. Abstamm. u. Vereb. 5:1–37.

Pridham, J. T., 1916. Oat breeding experiments. *In* Agri. Gaz. N. S. Wales 27:457–461.

Surface, F. M., 1916. Studies on oat breeding. III. On the inheritance of certain glume characters in the cross A. fatua X A. sativa, variety Kherson. *In* Genetics 1:252–286.

Tschermak, E. von, 1901. Ueber Züchtung neuer Getreiderassen mittelst künstlicher Kreuzung. Zeitschr. f. d. Land. Versuch. in Oest. 4:1029–1060.

————, 1914. Die Verwertung der Bastardierung für phylogenetische Fragen in der Getreidegruppe. Zeitschr. für Pflanzenzücht 2:308–311.

Zade, A. 1912. Der Flughafer. Deut. Landw. Gesell. Ab., 279:1–91.

————, 1918. Der Hafer, G. Fischer, Jena. pp. 217–225.

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CAPULINS ON SALE IN AN ECUADOREAN MARKET-PLACE

In every town and village of the Ecuadorean highlands huge baskets of capulíns are a daily sight in the market-place during at least three or four months of the year. The capulín is, in fact, the most important fruit of that region, judged either from the standpoint of production, or as a factor in the diet of the Indians who constitute at least three-fourths of the population. (Frontispiece.)

THE CAPULÍN CHERRY

A Superior Form of the Northern Black Cherry Developed in the Highlands of Tropical America

Wilson Popenoe

Agricultural Explorer, United States Department of Agriculture

AND

Abelardo Pachano

Quinta Normal de Agricultura, Ambato, Ecuador

THE improvement of our native fruits was begun shortly after the colonization of North America by Europeans. At first conducted in a somewhat haphazard manner, more recently in a very systematic way, the total result has been the production of many excellent varieties and hybrids, of which notable examples are to be found among the grapes, plums, and strawberries.

Our horticulturists, however, seem to have overlooked the wild black cherry, *Prunus serotina* Ehrh. Not so the aboriginal inhabitants of Mexico and certain other parts of tropical America, who have, on a number of high plateaus, cultivated this tree for centuries. They have so changed the character of its fruit that horticulturists familiar with it in the United States would scarcely recognize the capulín of Ecuador as belonging to the same species. Botanists, even, have considered it as distinct until very recent years, when closer study has served to show that it differs only in those characters which may be changed by cultivation. Its fruit, instead of being small, bitter, and having very scanty flesh, is sometimes the size of a Bigarreau cherry and much resembles the latter in flavor, except that there is usually a trace of bitterness in the skin. This characteristic, in the best varieties, is not so pronounced as to be objectionable.

The capulín is therefore a fruit worthy of serious attention in the United States as well as in other countries. It can be cultivated in many regions where European cherries are not successful, and it is tremendously productive. By means of vegetative propagation, which has never been practiced in tropical America (with the exception of a few sporadic instances in very recent years) it will be possible to establish as horticultural varieties the best seedling forms which have been developed, and perhaps to bring about further improvement. For it must be remembered that the process which has been employed in tropical America has been one of semiconscious selection, and that when a superior seedling appeared there was no means of perpetuating its good qualities. Improvement has therefore been slow, and has come about through raising the level of the whole species, instead of through repeated selection of superior individuals, followed by vegetative propagation.

HISTORY AND DISTRIBUTION

As an indigenous species, *Prunus serotina* is distributed from Nova Scotia westward to the northern shore of Lake Superior, thence southward to Florida, thence Northwestward to the Dakotas, eastern Nebraska and Kansas, thence through western Texas, southern New Mexico and Arizona into Mexico and probably Central America. It has generally been considered to be indigenous as far south as Colombia and Peru, but we are of the opinion that it has become naturalized in those countries in comparatively recent times. Father Bernabé Cobo, in his "Historia del Nuevo Mundo," one of the classic works on the natural history of the Spanish colonies in the New World, wrote in 1653: "This tree

occurs in cool regions, such as that of the Valley of Mexico, and it grows in this city of Lima (Peru), where it was brought, a few years ago, from New Spain (Mexico)." The historian Gonzales Suarez asserts (though without saying upon what grounds) that the plant was worshipped by the inhabitants of Cañar province, in southern Ecuador, before the arrival of the Spaniards. Modern authors usually base their belief in the indigenous character of this species throughout the Andean region upon the fact that it occurs there, at the present day, in a thoroughly naturalized condition.

At the time of the Conquest, the capulín was an important fruit-tree in central Mexico. It appears at least twice in the picture-writings which record the names and tribute required of towns conquered by the Aztec nation. From this and other evidence there can be no doubt that the name capulín (modified to capulí in South America), by which the tree is today known from Mexico to Peru, is of Mexican origin. Various derivatives of the word are found in dictionaries of the Nahuatl or Aztec language: Molina[1] gives *capulla* and *capulquauhtla* (*capulín* plus *quauhtla*, grove) as terms used to express a capulín orchard or grove; *capulquauitl* (*capulín* plus *quauitl*, tree), a capulín tree; and *capuloctli* (*capulín* plus *octli*, wine), a species of wine made from the fruit.

Probably the earliest detailed account of the capulín is that written by Francisco Hernandez, *protomedico* of the King of Spain, who was sent to Mexico to make a study of the useful and medicinal plants of that country. He devoted five years to the task, which was completed in 1575, and then returned to Spain, taking with him extensive manuscripts, of which copies were left in Mexico. The friar Francisco Ximenez published, in 1615, an annotated translation of these (the Latin original of Hernandez was not published until 1651), from which we reproduce below, in English, the chapter on the capulín. We have attempted to preserve the picturesque phraseology of the period in which the account was written, including the reference to the "hot" and "dry" nature of the fruit,—terms which were believed to indicate the effect which the substance under consideration had upon the human body, if consumed in quantity, and which were proper to the classification of drugs and foodstuffs used at that time by the Spaniards:

Chapter LXXI. Concerning the tree called Capulín, which bears the cherries of the Indies.

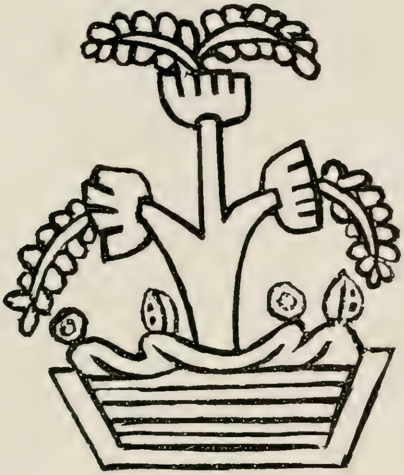
The capulín is a tree of moderate size, which has leaves like our almond or cherry, finely serrate, and pendent racemes of flowers, which develop into fruits altogether like our cherries in size, color, form, and in the seeds or stones, and which taste somewhat like blackberries, for which reason I think this tree must be classified among the species of cherries not known in the Old World, although some people think that it may be considered a kind of Metzi;[2] the fruit is a trifle acid and astringent, although when fully ripe it becomes sweet and loses much of its sourness and austerity and is pleasant to the taste, so much so, in fact, that many people who are competent to voice an opinion in such matters consider it by no means inferior to our cherries; it is hot and moderately dry in nature, with some astringency; they make of this fruit bread and wine, when there is lack of these substances, but it is melancholy nourishment, and in certain manner injurious to the heart; it imparts a bad color[3] to the teeth of those who eat it often, but this is easily avoided if a little care is given to cleaning the teeth; finally, there is no lack of persons who esteem this fruit above all others which ripen in the summer time,—milady epicure, though not usually satisfied with any but the fruits of Spain, sometimes chooses it in preference to the latter. It flowers in springtime, and yields ripe fruit almost throughout the summer; it grows in cool climates like that of Mexico City, where it is found in orchards and fields, and is sometimes given cultural attention, sometimes not. An infusion of the bark, left to stand in the sun for fifteen days, and taken in doses of one ounce, cures dysentery; reduced to powder, the bark removes films from the eyes and clarifies the vision; it cures inflammations, and softens and moistens the tongue when it is dry from fever, which latter effect is secured also by using the juice of the young shoots.

The capulín does not grow upon the coastal lowlands of Mexico, since it

[1] Vocabulario de la Lengua Mexicana, 1571 (Facsimile edition, published at Leipzig, 1880).
[2] *Ziziphus lotus* Lamk.
[3] The Latin original of Hernandez says "black color."

THE SWEET CHERRY OF THE INDIES

The "Capulín, seu Ceraso dulci Indica," (Capulín, or sweet cherry of the Indies) as figured in the work of Francisco Hernandez, written about 1575, and published in 1651. Hernandez praised the tree highly, both for its medicinal virtues and for its edible fruits; many people competent to voice an opinion on such matters, he says, considered the latter by no means inferior to the cherries of Spain. (Fig. 1.)



AN AZTEC HIEROGLYPH

The name *Capulapan* (a town in Mexico) as it was expressed in the picture writing of the Aztecs. The word is composed of two elements (above) a capulín tree, and (below) a canal (*apantli*) filled with water. The latter element gives the termination *apan*. The name may have been given to a place where there were capulín trees and water, or the picture may have been an attempt to represent phonetically the name *Calpulapan*. The trunk of the highly conventionalized tree was painted in brown, the leaves at the ends of the three branches green, and the clusters of fruits bright red. (Fig. 2.)

demands a cool, subtropical climate, such as that found at elevations between 4,000 and 10,000 feet. It is abundant, at the present day, in and about the Valley of Mexico, and the fruit is often sold in the markets of the City. Throughout the country it is known, so far as we have been able to ascertain, under the Aztec or Nahuatl name capulín; but it is reasonable to believe that there are distinct names for it in some of the other indigenous languages of Mexico.

In Guatemala the tree occurs, as in Mexico, throughout the highlands generally,—sometimes as a semi-cultivated plant, sometimes as a wild species, or at least having the appearance of one. Its zone of cultivation in this country lies between 4,000 and 9,000 feet, and most of the trees are found in the region known as Los Altos, between Guatemala City and Quezaltenango. The Kiché Indians who live near the latter city know the fruit as *tup*, and distinguish two varieties, the *ek-i-tup* (red tup) and the *sak-i-tup* (white tup), the latter having fruits of much lighter color than the former. The presence of a name for this fruit in the Kiché language argues an ancient cultivation in the Guatemalan highlands.

THE FAMOUS GONZALES CAPULIN TREE NEAR AMBATO, ECUADOR

This is one of the largest capulín trees in the Ecuadorean highlands, and at the same time one of the best, both in regard to productiveness and quality of fruit. It stands in the valley of the Rio Patate at Catiglata, a suburb of Ambato; the elevation of this region is about 8500 feet, and the climate is cool and dry. Its enormous crop matures during the first three months of the year: Figure 4 shows some of the fruits. Unless on very deep and fertile soil, capulín trees do not usually grow to more than half this size. (Fig. 3.)

Strangely enough, the capulín is practically unknown in Costa Rica, though abundant both north and south of that republic. Pittier does not mention it in his "Plantas Usuales de Costa Rica," nor were any trees seen during a three months' survey of Costa Rican fruits made by one of the present writers in 1920.

In the highlands of Colombia the tree is again found abundantly, and here as elsewhere in South America it is known under the Nahuatl name capulín, modified to capulí. The Spanish name *cerezo* (cherry tree; the fruit, *cereza*) is sometimes applied to it, both in Colombia and Guatemala; but most people recognize capulín as the correct appellation. Upon the broad plain surrounding Bogotá (the sabana, as it is locally called) there are many capulín trees, and the fruit is frequently seen in the markets of the capital. The elevation of this region is about 8,500 feet. The tree also grows upon the mountain sides between Bogotá and the Magdalena valley, down to elevations of about 5,000 feet; and we are assured that it is known elsewhere in Colombia.

Nowhere in the last-named republic, however, is the capulín so important

AN IMPROVED CAPULÍN FROM THE ECUADOREAN ANDES

These fruits from the Gonzales tree at Catiglata, near Ambato, shown natural size, represent the highest horticultural development of the capulín. They are dark purplish maroon, rather firm in texture, with greenish brown juicy flesh resembling the Bigarreau cherry in flavor. By means of grafting or budding, this excellent variety may be propagated for dissemination throughout many parts of the world. (Fig. 4.)

as in many parts of Ecuador. It may be said, in fact, that of all the countries where this tree is grown Ecuador is the one where it attains its greatest economic importance, and where the finest varieties are found. Theodor Wolf, the classic writer on Ecuador, says:

"The capulí is as distinguishing a characteristic of the Sierra as is the coconut palm of the coast. I do not doubt that it is indigenous, but commonly it is found in cultivation about the huts of the Indians, and in their fields and orchards."

Beginning in the northern part of the country, the tree is common in the province of Carchi, but not really abundant. The same is true of the vicinity of Ibarra, in Imbabura province. Toward Otavalo it occurs in greater numbers and along the shores of Lake San Pablo it is very abundant in the gardens and dooryards of the Indians. In Pichincha province, again, it is less conspicuous, though not by any means wanting. From Latacunga to Riobamba it is one of the few trees which grow upon the sandy plains, and it here attains greater economic importance than in any other part of the country. In the province of Azuay, however, it is nearly as abundant and important; and in certain sections of this province, together with the neighboring one of Cañar, it assumes the appearance of an indigenous species. In Loja it is not rare, but not sufficiently common to take a very important place in the list of economic plants. Its zone, throughout Ecuador, lies between 6,000 and 11,000 feet.

In Peru we have not studied in detail the distribution of the species, but it grows in several parts of the Andean region. It is particularly abundant in the valley of the Urubamba river, near Cuzco, at elevations between 8,000 and 10,000 feet, and it is cultivated in the city of Cuzco, at an altitude of about 11,500 feet. It is significant that the Indians of Peru and Ecuador, who speak the Quíchua language, should know this plant under a name taken from the Nahuatl tongue of Mexico. The numerous inquiries which we have made of Indians in Ecuador and Peru have failed to elicit any other name than capulí. This latter has, in Ecuador, been combined with Quíchua words to form compound terms, such as *sacha-capulí* (wild capulí), the name given to an Ecuadorean tree thought to resemble the capulí in appearance; and *Capulí-urcu* (capulí mountain), the name of a small peak.

South of Peru the capulín is not well known. There are a few trees in central Chile, chiefly in gardens and parks of the region about Santiago.

If by the name capulín we designate the cultivated forms of *Prunus serotina*, and not the species as a whole (a limitation which seems altogether appropriate), then we may say that this fruit has never been extensively planted in the United States; indeed, the only recorded instances of its having been grown in our country are a few from California. Strangely enough this fruit,—which was, after the Old World species brought by the Spanish monks, one of the very first exotics to be planted in that state,—has never become widely known there, although it succeeds remarkably at Santa Barbara. F. Franceschi, in his "Santa Barbara Exotic Flora" (1895), gives a somewhat detailed account of its behavior, which we transcribe below; it may be mentioned in passing that the *zapote* of which he speaks is *Casimiroa edulis* La Llave, and the famous old tree at Santa Barbara is believed to have been planted about 1810:

"In a lot adjoining that where the old zapote grows, and very likely planted at the same time, but in rather worse condition, is a tree of the Capullin (*Prunus capuli*), a kind of cherry, native not only of Mexico but extending in the temperate regions of South America down to Ecuador and Peru, but only west of the Andes. . . . Horticulturally speaking, this tree has a special importance for us, as well as for other warm countries, being the only cherry which will thrive in this

climate, growing to very large size, and bearing a profusion of fruits which are produced in bunches, possess a pleasant bitterish taste, and are very good, also, when dried. The chief importance of this tree will be, however, in the possibility of crossing it with some of the best cultivated cherries, if artificially they may be brought to flower at the same time. *Prunus capuli* blooms as early as January, and does not ripen its fruits till July. Two splendid specimens of this tree are to be seen on Mr. Lewis' farm near Carpinteria. They are some twenty years old, and seedlings of an older tree, now disappeared, which is said to have been introduced from Ecuador."

DESCRIPTION

In Mexico and Central America the capulín rarely exceeds 35 feet in height; in Ecuador it sometimes reaches 50 feet. Professor Sargent, in his "Manual of the Trees of North America," gives the maximum height of the species as 100 feet, but adds that it is "usually much smaller, and occasionally, toward the northern limits of its range, shrub-like in habit." During the first years of growth it is slender and pyramidal in habit; later the crown becomes somewhat more broad, rarely broadly oval or rounded in outline, with rather slender horizontal branches and slender, stiff branchlets, "at first pale green or bronze color, soon becoming bright red or dark brown tinged with red, red-brown, or gray-brown, and marked by minute pale lenticels during their first winter, and bright red the following year." The bark, which is one-half to three-quarters of an inch thick, is dark gray or ashy-gray in color, and "broken by reticulated fissures into small irregular plates, scaly on the surface" (Sargent). The leaves, which are commonly three to five and a half inches long, are somewhat variable in form: usually oblong-lanceolate, and long-acuminate at the apex. The margins are finely serrate, and the upper surface glabrous, dark green and shining, the lower surface also glabrous, and somewhat paler. The flowers, which appear when the leaves are about half grown, are borne on slender racemes four to ten inches long; they are white, about half an inch broad, and delightfully fragrant.

The fruit of the wild *Prunus serotina* is described by Professor Sargent as "ripening from June to October, in drooping racemes, depressed-globose, slightly lobed, ⅓ to ½ inch in diameter, dark red when fully grown, almost black when ripe, with a thin skin, dark purple juicy flesh of a pleasant vinous flavor, and an oblong-obovate thin-walled stone, about ⅓ inch long." This description must be altered somewhat if it is to cover the cultivated forms of the species; the best capulíns of Ecuador are depressed-globose in form, sometimes as much as one inch in diameter, and may vary from light maroon to deep purplish in color. The skin is thin, but not delicate in texture. The flesh is pale brownish green, melting and very juicy, with a sweet, vinous flavor strongly resembling that of the Bigarreau type of cherry, plus a trace of bitterness which is derived from the skin. The stone is proportionately no larger than in the best horticultural varieties of the Bigarreau type.

It must not be inferred from these remarks that all capulíns, either in Ecuador or any of the other countries of tropical America where the fruit is cultivated, are of this character. The vast majority of them are not over half an inch in diameter and are large-seeded, with scanty flesh of distinctly bitter taste. So far as we have observed, Mexico possesses no forms of such excellent horticultural character as those of Ecuador, nor does Guatemala. In fact, the majority of capulíns in all these countries amply justify Theodor Wolf in remarking that the fruit "is quite acrid, and can be eaten only in a country where there is a scarcity of better fruits." No one recognizes the truth of this better than ourselves; and it is precisely because of this condition that we have undertaken

to point out, in the present paper, the distinctly superior character of the horticultural forms which have been developed in Ecuador and to urge their propagation and dissemination.

We append a note[4] on the botany of the capulín, prepared by Dr. S. F. Blake, of the Bureau of Plant Industry, U. S. Department of Agriculture, which should serve to clear up the confusion in which the subject has long been involved.

USES

The capulín is used in the same manner as the northern cherry,—for eating out of hand, for preserving, for the preparation of jams, jellies, and so forth. In those countries where good varieties occur, it is popular among all classes of people; in other regions, such as the highlands of Guatemala, for example, it is esteemed principally by the poorer classes, since there are no varieties of sufficiently good quality to attract people who can afford to purchase better fruits.

In Ecuador, the fruit plays an important rôle in the economic life of the Indians, who have come to depend upon it as an important article of diet. It ripens during the first months of the year, "precisely when the peasants, and especially the Indians, have consumed the corn of the previous season's harvest, and cannot secure sufficient food for their needy families."[5] In point of quantity consumed, the capulín is doubtless the most important fruit of the Ecuadorean highlands.

The Indians, besides eating the fruit out of hand, use it to prepare a species of *cocido* or stew. It is said that a distilled liquor, resembling *kirsch* or *maraschino*, has been obtained from this fruit in Ecuador; but this has not been verified by us personally.

The medicinal uses of the capulín are not of great practical importance, though rather numerous and often mentioned in the literature of this tree. The account we have translated above from Ximenez gives a rather complete idea of its uses in Mexico during the early days of Spanish colonization. More recent works consider an infusion of the leaves to be valuable in combatting malarial fevers, and "the bark, especially that of the branches and roots, yields hydrocyanic acid used in medicine as a tonic and sedative."

Professor Sargent, from whom we take the last observation, remarks concerning the wood of *Prunus serotina*

[4] Botanical note: the capulín or ceraso, ranging from Mexico to Peru, has received several names at different times. *Prunus capuli* Cav. Anal. Hist. Nat. Madrid 2: 110. 1800; types from Ecuador and Peru. *Prunus salicifolia* H. B. K. Nov. Gen. & Sp. 6: 241. *pl. 563.* 1824; type from Colombia. *Cerasus capollin* DC.; Ser. in DC. Prodr. 2: 539. 1825; based on drawings of Mexican plants. *Cerasus capuli* (Cav.) Ser. in DC. Prodr. 2: 541. 1825. *Prunus capollin* (DC.) Zucc. Abh. Akad. Muench. 2: 345. *pl. 8.* 1837. *Prunus serotina salicifolia* (H. B. K.) Koehne, Deutsch. Dendr. 305. 1893. It has usually been distinguished from *Prunus serotina* Ehrh. by its supposedly narrower leaves, but examination of a large amount of material shows that this character is by no means constant, since broad-leaved forms occur in Mexico and narrow-leaved forms at various places in the United States. The only distinction which appears to be at all constant is furnished by the larger fruit and stones of the capulín, but this difference is precisely the one which would come from cultivation. In his treatment of the genus in the Standard Cyclopedia of Horticulture (5: 2842. 1916), Bailey retains *P. capollin* and *P. salicifolia* as distinct from *P. serotina*, but gives no satisfactory characters for separation. Koehne, in his latest treatment of the genus (Bot. Jahrb. Engler 52: 285-9. 1915), retains *P. capuli* as distinct, but brings forward no definite characters beyond its larger stone.

A study of Mr. Popenoe's specimens and of the extensive series in the National Herbarium has convinced me that the supposed species are botanically inseparable, as was long ago recognized by Sargent (Silva North Amer. 4: 46, footnote. 1892), and that the capulín is merely a cultivated form of *P. serotina*, which is presumably native southward into Mexico and introduced in early times into South America.

The following collections by Mr. Popenoe have been examined: Guatemala: Tecpan, 1916, Nos. 752a, 752b. Colombia: Nemocón, 1920, No. 1077; Bogotá, 1920, No. 1122. Ecuador: Ambato, 1921, No. 1232; Loja, 1921, No. 1319; Cuenca, 1921, No. 1332. Peru: Urubamba, 1921, No. 1358; Cuzco, 1921, No. 1362.—S. F. Blake.

[5] "Enumeración Botanica," by Luis Cordero, published at Cuenca, Ecuador, in 1911.

THE CAPULÍN, AS USUALLY SEEN IN MEXICO AND GUATEMALA

Large fruited forms of the capulín are rare in Mexico and Guatemala. The fruits shown above, natural size, are typical of the species as grown in those countries; while larger and better than fruits of the wild *Prunus serotina*, or choke cherry of the United States, they are greatly inferior to some of the best South American varieties. The flowers of the capulín are white, and deliciously fragrant: those shown above, together with fruits from the same tree, were photographed at Antigua, Guatemala. (Fig. 5.)

that it is "light, strong, rather hard, close, straight-grained, with a satiny surface, light brown or red, with thin yellow sapwood of 10 to 12 layers of annual growth; largely used in cabinet-making and the interior finish of houses." In Ecuador and other parts of tropical America, it is much used for making furniture. It has been extensively employed, also, for railway ties, but in recent years has been largely replaced by eucalyptus for this purpose.

CLIMATE AND SOIL

While we know that *Prunus serotina*, as a wild plant, extends as far northward as Nova Scotia, we have, as yet, no proof that the cultivated form of this species, which we term capulín, will prove to be sufficiently hardy for cultivation even in the central United States. It is a fruit which has been developed on the cool plateaus of tropical America, where temperatures lower than 15 or 20 degrees above zero Fahrenheit are never experienced. A careful trial will be required to demonstrate just how much cold the choice horticultural forms of this species can withstand without injury. At present, we would not feel safe in recommending them for any sections of the United States except the Pacific

Coast, the Southwest in general, and the Gulf States. Throughout this area the tree ought to succeed, so far as resistance to cold is concerned; whether or not good fruit will be produced is another question. In tropical America the capulín seems to be at its best in a relatively dry climate. The highlands of Ecuador and the plateaus of Mexico, for example, resemble southern Calfornia much more closely, in respect to climatic conditions, than they do the Gulf States or the Pacific Northwest. True, there are many capulíns in the vicinity of Bogotá, Colombia, where rainfall is much more abundant and is distributed throughout a large part of the year. We can only suggest, therefore, that the tree is likely to find conditions the most congenial in the semiarid Southwest, but that it may succeed, also, in the Gulf States generally, and perhaps even farther north.

As to soil, the capulín does not seem at all exacting, though it grows best, so far as we have observed, on sandy alluvial loam. We have seen it on heavy clay soils, and also on dry, rocky hillsides, as well as on the loose, volcanic sands which abound in the Ecuadorean highlands. It is safe to infer, therefore, that it can be grown successfully on any reasonably good soil. We have had no means of ascertaining whether or not it is alkali-resistant to a high degree.

Very little can be said concerning the cultural requirements of the tree, since it has not been subjected to systematic cultivation in Latin America. Data are, therefore, altogether lacking. If the trees are to be planted in orchard form, we would not recommend that they be set closer than 25 feet apart. Thirty-five feet would be better, particularly if the soil is of good quality so that large trees will result. If grown in a region of little rainfall, the capulín should be watered frequently,—at least every fortnight during the first few years after planting, and later about once a month.

Little pruning will be required, aside from that necessary to form a shapely crown and to eliminate dead or unhealthy wood. Since the fruit racemes develop from the leaf axils of the young branchlets, pruning which removes many of these latter should be avoided as much as possible. The capulín, which belongs to the group of cherries that bears its fruits in racemes, is much more productive than the cultivated cherries of northern countries, all of which belong to the group in which the fruits are produced in small clusters or cymes. A single raceme of the capulín often carries from six to ten fruits, and these racemes are produced in the utmost abundance from the leaf axils of the young branchlets.

PROPAGATION AND VARIETIES

As has already been mentioned, the capulín has been propagated in Latin America almost exclusively by means of seed. In recent years, one of the present writers has shown that grafting and budding can be employed successfully—as would be expected, *a priori*, since the genus Prunus lends itself to these methods of propagation throughout the world, in many distinct species.

We are in possession, therefore, of exceedingly simple and practical means of reproducing any chance seedling which produces fruit of superior quality and is otherwise desirable. The next thing to be done is to search out these choice seedlings, secure them for propagation, and then disseminate them as horticultural varieties throughout those regions of the world in which they will succeed. We can see no logical reason why the capulín, in its finer horticultural varieties, should not become an important and popular fruit in many parts of Latin America where it is now grown solely in its inferior seedling forms; also in certain portions of the United States, in southern Europe, and generally along the shores of the Mediterranean, in many parts of Asia Minor, perhaps in South Africa and Australia, and very likely in northern India and the surrounding regions.

A GRAFTED CAPULÍN TREE, TWO YEARS OLD

Until very recent years, the capulín has been propagated solely by means of seed. Experiments at Ambato, Ecuador, have shown that it lends itself to budding and grafting. It will not be difficult, therefore, to establish as horticultural varieties the choice forms which have originated in the Ecuadorean highlands. They cannot be reproduced from seed, for the capulín, like nearly all other tree fruits, usually reverts to the wild state when propagated by this means. The tree here shown is in the Quinta Normal de Agricultura at Ambato. Dr. Augusto Martinez, director of the Quinta, stands beside it. (Fig. 6.)

The numerous attempts which we have made to send seeds from Ecuador and Guatemala to the United States have shown that they are not easy to transport. Though packed carefully and in material calculated to keep them in good condition for at least one month, they have failed to reach the United States alive. We probably have not hit upon the right method of handling them, though we believe it will yet be possible to do this, for seeds of many other species of Prunus can be shipped without difficulty.

In the United States there should be no need of bothering with seeds of the capulín, since we can doubtless utilize those of our native form of *Prunus serotina* to produce stock-plants on which to bud or graft the finest capulíns from the Andean region.

When grown from seed the capulín, like nearly all other tree fruits, tends to degenerate; and among a hundred seedlings of a choice horticultural variety, probably not more than one or two will be equal to the parent in size and quality of fruit. Vegetative propagation must, therefore, be depended upon if the occasional superior varieties which originate as chance seedlings are to be reproduced on an extensive scale.

Experiments at Ambato, Ecuador, have shown that budding and grafting are both highly successful when properly performed. Grafting is practiced between the middle of July and the first of September, at which time the trees are semi-dormant; budding, on the other hand, is most successful if performed later than this, i. e., in that season which corresponds to the northern spring if the bud is of the type known in Spanish as *ojo despierto* (pushing bud) and earlier than grafting, if of the type known as *ojo dormido* (dormant bud). The common shield bud is used, or, in the case of grafting, a cleft or crown graft.

The grafts "take" (unite with the stock) within a few weeks' time, and it is common for them to flower by the end of the first year and to bear fruit the second. The only stock-plant so far employed is the seedling capulín, but it would be worth while to test several others, such as the sour cherry.

In such a region as that of Ambato, Ecuador, where climate and soil are both favorable and where the capulín has received a certain measure of cultural attention, no two seedling trees produce fruits exactly alike. There are, in short, almost as many varieties as there are trees. Only a few are worthy of propagation, and there are usually one or two trees which acquire a local reputation for superiority—such as that held at the present day by the famous old Gonzales tree at Catiglata in the suburbs of Ambato.

Early writers frequently refer to the varieties of the capulín, but usually do not go further than to say that they are two in number, the red and the white, or the red and the yellow; this is an allusion to the variation in color which exists, the fruit of certain trees being lighter colored than the normal form, which bears cherries of a deep purplish maroon.

It is not true that there are well-defined white or straw-colored varieties; there are all gradations in color between dark maroon-purple and light yellowish red, but the great majority of trees produce fruits of the normal purple-maroon, and it is indeed rare to find one of any other shade.

Much more important, from the horticultural viewpoint, are the differences in flavor which can be noted among the fruits from different trees in any region such as that of Ambato. Those of many trees are so bitter as to be disagreeable, while an occasional variety will be found to be sweet, pleasant, and altogether delicious. It is these latter which must be sought out and propagated if the possibilities of the capulín are to be fully realized, and if it is to become eventually, as we confidently believe it will, a popular fruit throughout the subtropical regions of the entire world.

MENDELISM IN FUR SHEEP CROSSES—II

THE ZYGOTIC CAUSE OF RED LAMBS, WHEN FUR SHEEP ARE CROSSED ON LONGWOOLS OR THEIR GRADE OFFSPRING

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IN A PREVIOUS article, published in the JOURNAL, it was shown from results obtained, that homozygous Karakul sires crossed on Longwool ewes gave complete dominance of black fur. However, a red lamb appeared occasionally. This red individual was of a different color from either of the original parent phenotypes.

In the JOURNAL OF HEREDITY, Vol. V, No. 4, April 1914, Dr. C. C. Young frequently mentions the lack of any systematic breeding methods among the breeders of fur sheep in their native home. He states that in May 1913 he imported a herd consisting of seventeen Karakuls, one four-horned, fur-bearing Karachiev ram, and one enormous *red* Kalmik, fat-rumped ram. He further states as follows, "The furriers who in their ignorance call Karakul skins, either full bloods or grades, 'Persian,' 'Persian Baby Lamb,' 'Persian Broad-tail,' or 'Astrakan' furnish the opportunity for certain breeders of *red* Persian, fat-rumped sheep, to dispose of their stock as 'Persian Broad-tails.' "

In view of these statements it is apparent that some so-called full blood Karakuls may carry the red factor recessively, due to crossing on these red strains in their native country. Unfortunately, from a scientific standpoint, the red lambs produced at the Dawley Farm were eliminated from the flock. Their skins, in every instance, were undesirable commercially, due to the fact that apparently the red color factor was correlated with loose, dull fleece. The exact behavior with respect to white and black fleece was, therefore, not established by direct crossing. However, it is unquestionably dominant to white (longwool) and recessive to black (Karakul). Purebred Longwools bred pure do not produce red lambs. In correspondence with Longwool associations and breeders no record could be found of a red lamb produced by registered Longwools, thus showing their freedom from the red color factor. On the other hand, Professor R. Owen Wahl, chief in charge of fur-sheep breeding work for Grootfontein School of Agriculture, Middleburg (Cape), South Africa, recently stated they had a full-blood Karakul ram in their stud that produced red lambs when crossed on full-blood Karakul ewes.

In 1912 Mr. F. E. Dawley, Fayetteville, N. Y., crossed full-blood Karakul sires on registered Lincoln, Leicester, Cheviot, Black Faced Highland and Cotswold ewes; this cross produced 106 black lambs and one red. In 1913 using the same cross, 111 were black and one was red. Both reds were by the same sire, but, the 1912 red was out of a Leicester ewe while the 1913 red was out of a Lincoln. The behavior of red with respect to white, in this case, can be explained when it is known that the reds in question were really not true red but more of a chocolate color. True reds were later produced in the F_2 generation by another sire.

Let (B) represent the black factor and (R) the red factor, then (b) and (r) show their respective absence. The Karakul sire, which produced the chocolate colored lambs, is homozygous for black color, but heterozygous for red color. He then has the zygotic constitution, with respect to color, of (BBRr), while the ewes are (bbrr). The sire forms gametes (BR) and (Br) in equal ratio, the ewes form gametes (br) only.

WHITE LONGWOOL EWES AND THEIR BLACK LAMBS

When longwool ewes are bred to full-blooded Karakul rams, the lambs are always black, and have wool of the popular "Persian lamb" type. The geneticist accounts for this fact by saying that black wool, with its correlated desirable factors of tight curl, density, and lustre is dominant over white, slightly curled wool. Black hybrid ewes of this type are in some cases worth as much as $250 each. (Fig. 7.)

On crossing, union occurs between gametes (BR), (Br), and (br) forming a heterozygote of the combination (BbRr) or (Bbrr). Both these zygote forms should be phenotypically black in color. In the case of the two chocolate colored lambs produced in 1912 and 1913 they could just as logically, from a genetic standpoint, have been called light colored blacks, in fact they were more black than red. As to why these particular two individuals should be light colored and not all others with the same zygotic combinations, can only be explained by assuming that the particular black factor in the form (BbRr) in their case failed to give complete dominance. The results obtained later when the black F_1 ewes were crossed further strengthen the above assumption.

In 1914 the F_1 ewes were bred to an imported full-blood Karakul ram named Pultava. This ram, it was naturally supposed, would give complete dominance of black fleece, together with its correlated desirable factors of tight curl, density and bright luster. Fifty-six F_1 black ewes bred to Pultava in 1914 produced 41 blacks, 11 red or spotted, and 11 whites. In 1915 he was bred to 100 black F_1 ewes, as the 1913 ewe lambs were now ready to breed, and produced 80 blacks, 17 red or spotted, and 14 whites. The two years then give the produce of 156 F_1 ewes, with a combined total of 174 lambs of which 121 were blacks, 28 red

PULTAVA, AN IMPORTED KARAKUL RAM

He was supposed to be a pure blooded Karakul, but proved not to be as he sired many red, white, and spotted lambs. About one-third of his offspring were off color, showing that he was heterozygous for these desirable factors, and of little value for breeding purposes. Karakul sheep are black but as they grow older their fleece turns gray, or nearly white, only the short hair on legs and face retaining its original color. (Fig. 8.)

or spotted, and 25 whites. The question now arises, was this appearance of such a large number of white, red, and spotted lambs due to the known heterozygous condition of the F_1 ewes, or was it the fault of the full-blooded, imported sire, Pultava? Apparently Pultava was the cause. On the basis assumed in the original hypothesis one of the 1912 and 1913 sires was heterozygous for red (R), giving him the form (BBRr). The Longwools (bbrr) producing heterozygotes (BbRr) and (Bbrr) in equal ratio. However, the second sire produced no light colored blacks out of over 100 lambs; it is therefore safe to assume he was free from the red color factor (R), making his zygotic form (BBrr), with possible gametes of (Br) only. The resulting zygote from a cross on the Longwools would contain only a single dose of the black factor (B), although, of course, it is possible for a zygote, if properly made, to have a double dose of any factor. The only possible zygotic form for the F_1 ewes with respect to color then is (Bbrr) and (BbRr), with a mathematical ratio of three (Bbrr) forms to one (BbRr) form, because one sire produced only (Br) gametes, while half of the other sires' gametes were (Br) also.

When the F_1 ewes form gametes a separation takes place between the part of the zygotic cell containing (B) and the part which does not contain it (b). Half of the F_1 gametes, therefore, will be carriers of the black factor (B), which is apparently correlated with the

ONE OF THE RED LAMBS SIRED BY PULTAVA

His dam was a black first generation hybrid ewe, like the lambs shown in fig. 8. Had his sire been a pure Karakul he would have been black, and a valuable animal from the breeder's point of view. The relationship of these color factors is of great practical importance in producing high grade fur sheep. (Fig. 9.)

desired density, luster and curl, and half of the gametes will be totally lacking in this factor (b).

It is evident Pultava could not have been homozygous for the black factor (B), because he produced many red, spotted, and white lambs. Assuming then that Pultava had to be heterozygous for the black color factor (B) he could have had any one of the following heterozygotic forms with respect to color factor red (R): 1. (BbRR) 2. (Bbrr) 3. (BbRr). Running through the series of possible heterozygotic forms for the F_1 ewes, mating from this assumption would have resulted as shown in Table I.

Of the three possible forms listed in Table I it is apparent Pultava could only have been of the form (BbRr). The theoretical possibilities are very close to the actual obtained results; as is shown in Table II.

It must be remembered, however, that twenty-five percent of the F_1 black ewes have a possible heterozygous constitution of (BbRr); crossing these gametes gives results as shown in Table III.

Again the theoretical possibilities check close enough with the obtained results to make the (BbRr) assumption entirely probable; as is shown in Table IV; the apparent difference of 33 to 28 and 11 to 25 is not significant when it is remembered that the average ratio of

A SIX HORNED KARACHIEV RAM

The rams of this strain normally have four horns, the ewes two. His parents were normal Karachiev sheep, and all his offspring by ewes of this breed have had the usual complement of horns. When bred to Lincoln ewes all of his lambs were without horns, so that the genetic factor producing extra horns seems to be entirely lacking in dominance. (Fig. 10.)

3 to 1 of Table II and Table IV must be considered in the final analysis.

The average ratio of Tables IV and VI must be considered when figuring the average total theoretical possibilities, and checking same with obtained results. The average of these two tables based on their 3 to 1 ratio gives results as shown in Table V.

The average brings the theoretical possibilities still closer to the obtained results and further strengthens the assumption that the heterozygotic form of Pultava, with respect to color factors was (BbRr). It is assumed that reds and spotted had the same heterozygotic form in their germ cells, with respect to color factors. With the exception of two lambs which were of black mosaic pattern the spotted lambs showed a predominance of red pattern. The black mosaics must have been of the form (Bbrr), although the forming of a mixed phenotype of this combination is apparently of infrequent occurrence.

The zygotic relationship of these color factors and their respective absence is very significant from a practical standpoint, due to the character of the various skins produced. Even though

the fur is black in color there is a vast difference in shade, density, pattern arrangement, and luster. In the F_1 generation no extremely high class skins were obtained, although some of the skins from this first cross sold as high as $18.00 to $25.00. Due to the heterozygous condition of Pultava there were only a few high class skins produced in the second cross; however, had Pultava been homozygous for black and free from red, high class skins would have been much more frequent, due to the fact that the desirable qualities previously mentioned are unquestionably closely correlated with black color. The lambs having high class skins should be of the zygotic form (BBrr) with respect to color factors. The zygotic constitution of the grade ewes is, therefore, very significant also.

Professor R. Owen Wahl, of South Africa, who has bred fur sheep for years, reports similar results from using one particular ram of supposed full-blood origin. His results check with the data presented. They obtained all forms of blacks, spotted, reds and whites.

The Karachiev is a strain of fur-bearing sheep in which the rams normally have four horns, while the ewes have only two. A six-horned ram was dropped by a normal two-horned Karachiev ewe, at the Dawley Farm, Fayetteville, N. Y. The sire of this six-horned individual was a normal four-horned Karachiev ram. In all cases where this six-horned ram has been bred to Karachiev ewes the ram lambs have had the normal four horns and the ewe lambs two horns. He has been bred to a few Lincoln ewes and none of the lambs have had horns, although lambs of both sexes have been produced.

TABLE I

	Zygotes							
Pultava.×75% F_1 Ewes.=	*Black.*	*Black.*	*Black.*	*Red.*				
1. (BbRR×(Bbrr)=	(BBRr)	(BbRr)	(BbRr)	(bbRr)				
	Black.	*Black.*	*Black.*	*White.*				
2. (Bbrr)×(Bbrr)=	(BBrr)	(Bbrr)	(Bbrr)	(bbrr)				
	Black.	*Black.*	*Black.*	*Black.*	*Black.*	*Black.*	*Red or spotted*	*White.*
3. (BbRr)×(Bbrr)=	(BBRr)	(BBrr)	(BbRr)	(Bbrr)	(BbRr)	(Bbrr)	(bbRr)	(bbrr)

TABLE II

		Total	*Black*	*Red or Spotted*	*White*
Theoretical Possibilities:		8	6	1	1
" "	×21.75	174	130.5	21.75	21.75
Obtained Results:		174	121	28	25

TABLE III

Pultava×25% F_1 Ewes.

	Blk.	*Blk.*	*Blk.*	*Blk.*	*Blk.*	*Blk.*	*Blk.*	*Blk.*
	(BBRr)	(BBRr)	(BbRR)	(BbRr)	(BBRr)	(BBrr)	(BbRr)	(Bbrr)
(BbRr)×(BbRr)=								
	Blk.	*Blk.*	*Red.*	*Spotted or Red.*	*Blk.*	*Blk.*	*Spotted or Red.*	*White.*
	(BbRR)	(BbRr)	(bbRR)	(bbRr)	(BbRr)	(Bbrr)	(bbRr)	(bbrr)

TABLE IV

		Total	*Black*	*Red or Spotted*	*White*
Theoretical Possibilities:		16	12	3	1
" "	×10.9	174	130.5	32.6	10.9
Obtained Results:		174	121	28	25

TABLE V

	Total	*Black*	*Red or Spotted*	*White*
Theoretical Possibilities:	174	130.5	24.5	19.0
Obtained Results:	174	121	28	25

"THE CATLIN MARK"

The Inheritance of an Unusual Opening in the Parietal Bones

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"EYES" IN THE BACK OF HIS HEAD

This is not, as it appears, an attempt on the part of nature to meet the proverbial small boy's demand for "eyes in the back of his head." The holes serve no such useful purpose, but show the inheritance of an entirely useless or even injurious character. (Fig. 11.)

TWO VIEWS OF THE "CATLIN MARK"

Above (C), is shown an X-ray photograph of the defect in the skull of one of the daughters of the man shown below (D). The presence of this defect in the skull has no influences on mentality, and causes only slight inconvenience, although a baby with a large "Catlin Mark" is more liable to injury at birth. (Fig. 12.)

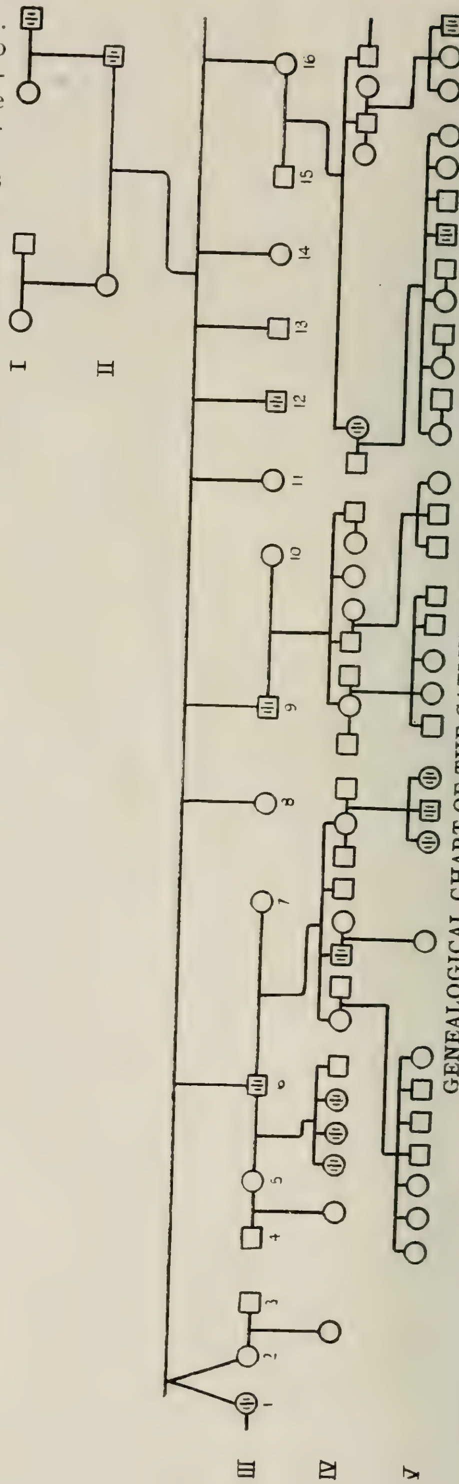
THE accompanying figures are intended to present certain facts regarding the inheritance of a very unusual defect, namely, an opening in the parietal bones. The radiographs show the position of the opening. The exact location is more clearly shown by the picture of the skull. (Fig. 11.)

In the particular individual, whose radiograph is shown in C, Fig. 12, the opening in the left parietal is larger and more irregular in contour than the right. It will be noted in D, that the father of C has a similar skull defect. Furthermore, as the family chart shows, Mr. Catlin, III, 6, has two brothers and one sister similarly affected. The "mark" was traced up the male line to the grandfather of the man whose photograph is shown in Fig. 12 where the history was lost. (See Fig. 13.)

The four branches of the family which produced offspring are indicated on the family chart. The affected

members of the family are indicated. The hereditary defect did not seem to fall in line with the usual laws of inheritance; however, sufficient evidence was not available for a definite conclusion.

Aside from the transmissibility, it is interesting to note that the size of the openings varies to a certain extent with the age of the individual. Figures 14 and 15 are skiagraphs of the skulls of the younger members of the Catlin family. It will be noted that in each case the two holes are so large that they are continuous save for a median cartilaginous septum which is not clearly differentiated by the X-ray. In most cases it is claimed that the original single large elongated opening of the young is later developed into two more or less circular ones by the ossification in the median region. For example, Ruth, whose "mark" is shown in C, claims that in childhood there was only a single elongated opening in her skull, as is the case with one of her younger sisters whose "mark" is shown in Fig. 15. The suture lines between the two holes in the skull shown in C unite with the sagittal suture in such a way as to suggest that the median bridge is formed by a simultaneous upward ossification of the lower median side of the elongated opening and a downward ossification of the upper median region. This gives four centers of ossification, an upward growth from the median edge of each parietal and two similar downward ossifications. In many cases an elongated concavity remains in the median septum as shown in D, Fig. 12. Although this post natal ossification is marked in some individuals the septum between the openings does not form at any particular age. Some children were found who possessed openings in the skull as large as a twenty-five cent coin. This fact might help to explain why the transmission of the defect appears to be so haphazard. It is quite possible that the "mark" appears in many individuals not so indicated on the chart. In one particular case, a mother contended that her small son



GENEALOGICAL CHART OF THE CATLIN FAMILY. (Fig. 13.)

THE "MARK" IN CHILDHOOD

Like the normal opening that occurs in the skull in infancy, and closes by the end of the first year, this opening grows smaller, and in some cases closes entirely with age. Frequently it appears as a single large hole, or with a very slight suggestion of a median bridge, as in this case. (Fig. 14.)

was normal in this regard when an examination revealed a slight abnormal concavity in the skull where the openings were expected. In this case the X-Ray would not show the defect, but the boy was recorded as having an abnormal skull. Unquestionably many of the individuals who are shown in the chart as normal, possessed the defect in fœtal or embryonic condition.

The "Catlin Mark" does not seem to be a serious handicap to its possessor. After considering the individual cases it was readily seen that no relation existed between the defect and mentality. The family as a whole would be classed as "average." One boy who had no signs of the mark is retarded in the grades while another child who has unusually large openings in the skull is quite successful in school work. Those who have the defect claim that any stroke on that part of the head causes unusual pains and headaches. The young ladies say that in case the hair is dressed a certain way a pressure is exerted and violent headaches result. To this extent, only, is the defect an inconvenience to an otherwise normal individual. However, the family physician claims that a child with an extreme "Catlin Mark" is more liable to injury at birth than a normal child.

A SINGLE LARGE "MARK"

Later in life this hole will partly close, and be divided into two smaller ones by the formation of a median septum. In view of the existence of such natural defects, one is led to wonder whether some cases of trephining reported by archeologists may not be due to such a defect as this. Primitive man undoubtedly did perform operations on the skull, but in some of the examples found the holes are remarkably smooth, suggesting an origin similar to the above. (Fig. 15.)

The Undeveloped Mind

THE PSYCHOLOGY OF CHILDHOOD, by Naomi Norsworthy, Ph.D., formerly associate professor of educational psychology, Teachers' College, Columbia University, and Mary Theodora Whitley, Ph.D., assistant professor of education in the same college. Pp. 375. Brief Course series in Education, New York, The Macmillan Co., 1920.

This textbook for normal schools covers in a rather complete way the original nature of the child, with reference to methods for educating or modifying it. Particular pains are taken to attach the proper importance to heredity—in this respect the book is a model of its kind, even though the discussion of the theoretical phases of genetics is hardly up to date. In general, the volume presents the point of view associated in psychology with the name of E. L. Thorndike. While intended primarily for embryonic teachers it should be of interest and value to well-educated parents also.—P. P.

BARLEY (

On the left are plants grown from seeds harvested only six days after they were pollinated; on the right are
old weighs only 5 milligrams, instead of 35 milligrams for a normal adult grain. The small seedlings, although

THE GERMINATION OF BARLEY SEEDS HARVESTED AT DIFFERENT STAGES OF GROWTH

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and

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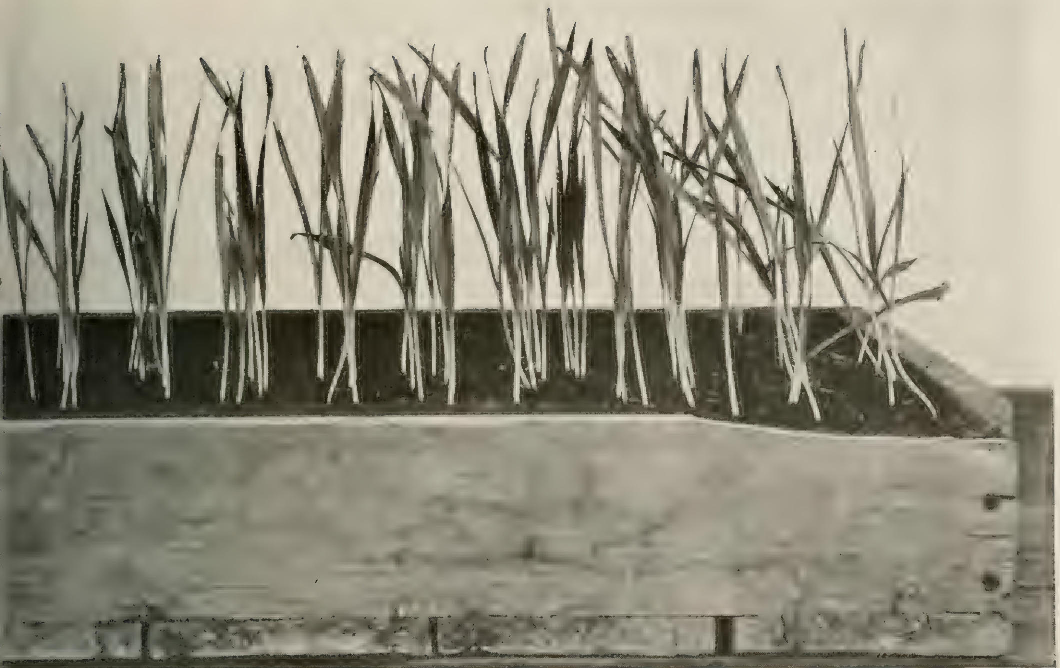
AT ABERDEEN, Idaho, where these experiments were conducted under irrigation, in cooperation with the Idaho Agricultural Experiment Station, a kernel of Hannchen barley is normally mature at 26 days after flowering. In 1920 an experiment was undertaken to determine the earliest date after pollination at which seeds were sufficiently developed to germinate. In this experiment samples from seven varieties were taken. Three of these varieties were six-rowed and four were two-rowed. Sufficient spikes of equal development were tagged in each variety. The dates of flowering of the spikes were determined by observations and later checked by measurements of the kernels. These dates are not absolutely accurate as the flowers on a spike are not all fertilized on the same day. In all varieties the tip and basal flowers are pollinated later than those on the central part of the spike.



NATION

from mature seeds, with intermediate stages at intervals of one day. The dry matter in a barley seed six days more slender than those from mature seeds, develop normally and produce seed. (Fig. 16.)

In the six-rowed varieties the flowers of the central rows are pollinated before those of the lateral rows.

In four of the varieties the first samples were taken six days after flowering. In one variety the first sample was taken seven days, in a second, eight days, and in a third, nine days after flowering. These samples were taken by cutting the culms and placing the spikes in paper envelopes. The seeds were not taken from the spikes until the following winter when the germination was tested by sowing the seeds in flats in the greenhouse at Arlington Farm, Virginia. The seeds were placed in rows spaced at definite distances and covered lightly with soil.

When the experiment was planned in 1920 it was thought that germination would first occur in seeds which had developed for about 14 days. In mature seed the embryo is provided with an epithelial layer which secretes the diastase necessary for the digestion of the starch endosperm. The epithelial layer is not fully formed until about the 14th day after the flower is fertilized. There are several other changes that take place at this time which indicate approaching maturity. A secondary stage of starch formation commences. The peak of the water content of the kernel is reached at this time.

It is readily seen in the table that the hypothesis of time of germination was not correct. It was thought that all samples were taken sufficiently early to show the inception and gradual increase in percentage of germination. All of the varieties showed germination at six days from flowering. The Baku variety gave a perfect percentage of germination at that age. It may be possible that the Gatami shows the progress that should be expected. On the 6th day after flowering four of the seven central kernels germinated while only three of the seven lateral ones germinated. On the 7th day all of the central kernels were viable while only six of the seven lateral ones grew. It was not until the 8th day after the spikes were recorded as flowering that

all of the lateral kernels could be germinated. The flowers of the central spikelets are pollinated first. The lateral ones usually are pollinated one or two days later.

Barley kernels six days of age are very small. They have a very high water content and when dried are so small and brittle as to be difficult to handle. In the average kernel of Hannchen barley at this stage there are only 5 milligrams of dry matter, while at maturity there are 35. The plants produced from these small kernels are very slender and the first leaves are very small. They are perfectly normal, however, and develop into normal plants which produce seed. When grown under the conditions of this experiment the adult plants were not as robust as those from mature seed, but this may have been a result of their having been transplanted. The seedlings were progressively taller and had greater diameter of stem with the increase of the age and size of seed, as may be seen in Fig. 16.

In 1921 a more accurate study was made with Hannchen barley. Several hundred flowers were emasculated within a period of three or four hours. Two days later these were hand-pollinated and a record made of the exact time of pollination. As barley pollen either germinates or dies within a few minutes after the anther is ruptured, the ages of these kernels are known certainly within one hour. As will be seen in the

Results of experiments in germination of kernels of barley varieties harvested at different stages of development after flowering

	1920																				1921	
	Himalaya				Gatami				Manchuria				Hannchen		Jet		Baku		Chevalier		Hannchen	
Days from Flowering	Central Kernels		Lateral Kernels		Central Kernels		Lateral Kernels		Central Kernels		Lateral Kernels											
	Planted	Germinated	Planted	Germinated	Planted	Germinated	Planted	Germinated	Planted	Germinated	Planted	Germinated	Planted	Germinated	Planted	Germinated	Planted	Germinated	Planted	Germinated	Planted	Germinated
2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	10	0
3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	10	0
4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	10	0
5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	10	9
6	9	8	10	8	7	4	7	3		...	...	...	...	...	...	...	5	5	10	4	10	6
7	10	9	10	9	7	7	7	6	10	10	9	9	...	...	...	...	3	2	10	8	10	6
8	9	9	9	6	8	8	8	8	12	12	12	10	9	8	...	...	5	4	12	11	10	8
9	10	9	10	10	7	5	7	7	11	11	9	9	12	11	6	6	5	5	11	9	10	7
10	10	10	10	10	10	10	10	9	13	13	13	12	11	11	4	4	5	5	10	10	10	2
11	10	10	10	10	8	7	8	7	8	8	8	7	13	13	6	6	7	7	12	10	...	...
12	7	7	7	7	8	8	8	7	7	7	7	6	10	10	4	4	7	7	10	8	...	...
13	8	8	8	8	9	9	7	7	11	11	9	9	12	12	6	6	4	4	...	...	...	...
14	10	10	10	10	6	6	6	6	7	7	7	7	11	11	8	8	6	6	...	...	...	...
15	9	9	9	9	7	7	7	7	10	10	9	9	13	13	7	7	7	7	...	...	...	...
16	10	10	11	11	8	8	8	8	12	12	12	12	12	12	7	7	6	6	...	...	...	...
17	9	9	9	9	7	7	7	7	12	12	12	12	10	10	8	8	8	8	...	...	...	...
18	10	10	10	10	7	7	7	7	9	9	9	9	10	10	7	7	6	6	...	...	...	...
19	9	9	8	8	8	8	8	8	13	13	11	11	10	10	8	8	8	8	...	...	...	...
20	9	9	9	8	7	7	7	6	...	...	...	...	...	...	7	7	7	7	...	...	...	...
21	...	...	...	...	7	7	6	6	...	...	...	...	...	...	9	9	8	8	...	...	...	...
22	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8	8	7	6	...	...	...	...
23	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8	8	8	8	...	...	...	...
24	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8	8	6	6	...	...	...	...
25	...	...	...	...	...	...	...	...	...	...	...	...	...	...	6	6	...	...	...	...	...	...

table, nine out of ten kernels germinated at an age of five days from the time they were pollinated. The fact that so many kernels germinated at five days and the irregularity of the later germinations indicate that an occasional seed might be found which would germinate at less than five days.

There is some question as to the effect of the kernels being allowed to remain on the spike as was done in this experiment. The spikes dry very rapidly at Aberdeen. It is thought that no additional material enters the seed from the spike for a period longer than one hour after the culm has been severed from the plant. Further experiments are being conducted to discover more of the details of germination at early ages.

SOME POINTS ON THE RELATION OF CYTOLOGY AND GENETICS

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IT IS necessary to point out certain misstatements of fact made by Miss E. Eleanor Carothers in her review of Sharp's *Cytology* in the Journal of Heredity (Vol. 12, p. 351). This is not the place for a discussion of detailed cytological points, and reference will only be made to certain general features, particularly those having a direct bearing on genetics. Miss Carothers has rightly pointed out certain defects in the work in question which are capable of being remedied in a later edition. But she makes a serious blunder in discussing the phenomena of meiosis in plants, with which she evidently has had little experience. She refers to the statement of Sharp that in diakinesis the heterotype chromosomes contrast strikingly with the chromosomes in an ordinary somatic prophase, whether they are secondarily split or not. But she goes on to affirm that "this 'striking contrast,' however, depends wholly upon the fact that the chromosomes are secondarily split, that is that they are tetrads and not dyads." She also states that she "has had enough contact with botanical material to be confident that this statement is true for plants as well as animals."

This statement is particularly unfortunate, because the understanding of meiosis as it occurs in most plants was retarded for a decade by the search for "tetrads" where they do not exist. It is now well recognized by most plant cytologists that in the majority of plants tetrads do not occur, and that the essential feature of the heterotypic mitosis is the separation of pairs of whole chromosomes. It is easy for such pairs of chromosomes (gemini) to be mistaken for tetrads through a superficial examination, particularly if the observer has the necessity for finding "tetrads" already in mind. As regards animals, there are many instances in which clear tetrads have been observed, but that they are certainly not universal is shown, for example, by the history of the X Y chromosomes in many forms, to take a single example. Some of the more careful recent papers on animal spermatogenesis discard the conception of tetrads and speak of bivalent chromosomes in diakinesis.

The presence of tetrads merely indicates that the paired chromosomes have themselves split before the separation of parts begins. Such a split is necessarily precocious. When this split occurs in the heterotypic anaphase or telophase, as it does in Oenothera and Lactuca among forms which I have studied critically, then obviously the

chromosomes will be bivalent and not tetravalent in diakinesis or the heterotypic prophase.

From a genetic point of view also it is particularly desirable that the conception of tetrads should not be introduced where they do not exist. In such cases the essential feature of meiosis is the *separation of the chromosome pairs*, and the complications introduced by the formation of tetrads and the resulting possibilities in the distribution of the four segments in the two divisions, do not arise.

Whether the pairing of chromosomes is parasynaptic or telosynaptic is, therefore, a matter of cytological detail which need not *necessarily* affect the distribution of the chromatic material. But this is a subject into which I do not propose to enter here. One must expect to find differences in detail, and even in important points as well, between the phenomena of meiosis as observed in different organisms. The time has passed when it is reasonable to try to squeeze them all into one mould. Since considerable attention has been given recently to the cytological basis of "crossing over" it may be worth while referring to a few points in this connection, in order to show that some plants provide a cytological basis for such phenomena while others do not.

It was recently shown that in Lactuca[1] the chromosomes in early diakinesis are twisted around each other, and that this twist often persists as the chromosome pairs condense. This would lead to a breaking across the twist when the pairs separate, in other words to crossing over. Such twisted pairs of chromosomes have often been figured during diakinesis in various plants, for example in *Adoxa moschatellina*[2] and in Smilacina.[3] But I believe the later consequences of the twist have first been traced in Lactuca. In sharp contrast to the twisting and probable crossing over of chromosome segments in Lactuca is the condition in Oenothera, where such twisting has never been seen and is not to be expected on account of the short and stout shape of the chromosomes.[4] As is well known, in Oenothera the chromosomes form a chain end-to-end like a string of sausages, and when they ultimately come to be side-by-side in diakinesis they are already in the short and stout condition in which twisting about each other is impossible. This is a very disturbing fact for those who write about "crossing over" in Oenothera, and obviously if such crossing over occurs in Oenothera the phenomena will have to find some other explanation.

[1] Gates and Rees. 1921. A cytological study of pollen development in Lactuca. Annals of Botany 35: 365-398, pls 4.

[2] Lagerberg, T. 1909. Studien über die Entwicklungsgeschichte und systematische Stellung von *Adoxa moschatellina* L. Kungl. Svensk. Vet. Akad. Handlingar, Vol. 44, No. 4.

[3] Lawson, A. A. 1912. A study in chromosome reduction. Trans. Roy. Soc. Edin. 48: 601-627.

[4] See Gates, R.R. 1908. A study of reduction in *Oenothera rubrinervis*. Bot. Gazette 46: 1-35.

EUGENICS AND HUMAN MORALITY[1]

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WHENEVER people meet nowadays to discuss delinquency, there is likely to be heard a complaint that the accepted standards of conduct are coming to be more and more disregarded; that the old ideas of morality are going into the discard; that the younger generation, in particular, is less and less influenced by the customs of respectability and decency which had, it is averred, a binding power a few decades ago.

It is, therefore, desirable that the current ideas about morality be carefully examined by all thoughtful people. Such an examination involves some of the broadest and most fundamental concepts with which the human mind has dealt. Whole libraries of books have been written on or about the subject. I am sure I will be pardoned, therefore, if I attempt to do nothing more than indicate a few of the salient points in a single line of reasoning. This line of reasoning will lead to the conclusion that better and more widely observed standards of morality depend largely on an increase in the average level of intelligence of the population; which increase is in turn dependent on changes in the birth rate. This is, of course, only a single point of view of an extremely complex subject which also can be, and ought to be, viewed from other angles.

To begin, then, what is morality?

A man's conduct or behavior, as it affects others than himself, is influenced by a wide variety of factors, and to the working of certain groups of these the term "morality" is loosely and often vaguely applied. For the present purpose it will be convenient to review a few of the kinds of influence that have determined the nature of human conduct at one time or another. Without going into a critical or exhaustive analysis of the subject, one may readily recognize five categories.

THE ELEMENTS OF MORALITY

1. *Instinct.* In lower animals, conduct is directed largely, in most cases wholly, by certain innate and slightly modifiable tendencies, desires, and impulses which are often loosely grouped together under the name of instinct. No doubt man in his earliest period was so guided,—as he is still to a large extent. But as he became more of a social animal, mere instinct did not suffice. True, the instincts for action in conformity with "the herd" are just as genuine as the instincts for wholly selfish action. But some of the more powerful instincts, such as those connected with pugnacity, deceitfulness, hoarding, and sex, are largely individualistic, and their expression may frequently get an individual into trouble with the herd. Instinct alone is not, in a modern human society, even an adequate guide for the conduct of domesticated cats and dogs,—much less for the human members of the community. Yet a certain school of self-styled advanced thinkers looks to it as a guide in problems of conduct, urging that obedience to instinct is the duty and privilege of the "free man." Unless this view is seriously qualified, it is hardly necessary to say that it is at least 10,000 years behind the times.

2. *Custom.* The lines of conduct evolved as the result of conflict and compromise between selfish instinct and the requirements of co-operative social life steadily increasing in complexity, have led to the establishment of mores, folkways, written or unwritten laws,

[1] Address before the Section on Delinquency, California Conference of Social Work, San Diego, April 26, 1922.

customs, which have been held up as the pattern for the conduct of the individual. In many primitive communities these are almost inexorable; and even yet, in the highest civilization of the present day, they are perhaps more important than any other one factor, in the code of morality.

3. *Revelation*. These customs were in almost all societies backed up, reinforced, and supplemented by revelation of a supposed divine standard of conduct, handed down from above by some superhuman power. Such revelation, whether it be the Ten Commandments, the Koran, or the sacred writings of any other people, has for long periods been accepted as an unquestionable rule for guidance, and is to a large extent so accepted at the present day. The authority of revelation is rapidly breaking down, however, for reasons that need not here be rehearsed; moreover, most of the extant revelations are of some antiquity, and not always easy of application to modern problems.

THE CONSCIENTIOUS MAN

4. *Conscience* is relied upon by many as a supplement to or replacement of the preceding factors. Of all injunctions for the guidance of conduct, the exhortation to "obey the dictates of your own conscience" is perhaps the worst; for "conscience" is often but a vague and mystical name for the collection of prejudices and unrecognized complexes that exist in the human mind, and action upon it is no safe basis for successful adjustment. Frequently the conscientious ideas are the results of internal, mental conflicts: they are merely expressions of the individual's more or less unsuccessful attempt to solve some of his pressing problems. For illustration, I take the case of the so-called conscientious objectors in the Great War. I am not referring to those who had a "streak of yellow," and grasped at any straw to evade military service; nor to those who honestly believed—for reasons unacceptable to their fellow-citizens—that the United States was on the wrong side of the conflict. I am speaking of the genuine pacifist, who felt willing to suffer any indignity rather than to take up arms and shed the blood of his fellow-men. For the present purpose, it makes no difference whether these men were ethically right or wrong: I am merely describing the mechanism of belief. These martyrs—at least, those of them who were sent to the penitentiary—were found by mental test to be far above the average in intelligence.[2] What did their conscience on this point amount to? Different things in different cases, of course; but in many instances it showed nothing more than that its exponent had had domestic infelicities —or, to put it more crudely, a nagging wife. The mind unconsciously set up a defense against an unbearable domestic situation, in a strong feeling of the wrongfulness of conflict of any kind, and a strong demand for peace at any price. A man who, because he has been henpecked, develops beliefs that make him willing to go to the penitentiary rather than to share in the glory conferred by popular excitement on the participants in a "war to end war," is a proper subject for sympathetic and scientific understanding; but it is quite out of the question for his fellow-citizens to venerate his emotional attitude as a form of superior and divinely-inspired guidance in the most important affairs of life. Conscience, which might in many cases be more correctly termed "unconscience," is not a dependable counselor.

THE APPLICATION OF INTELLIGENCE

5. *Analysis*. The last type of standard for conduct, or basis for morality, to which I shall refer, is analysis based on an intelligent appreciation of the probable consequences of an act.

[2] *Memoirs of National Academy of Sciences*, Vol. xv, "Psychological Examining in the U. S. Army," ed. by R. M. Yerkes, Washington, 1921, p. 802 ff. Objectors of the political type were markedly more intelligent than those of the religious type, but both were far above the average of the draft.

It goes without saying that no complicated action of an individual is determined by only one of these factors. Ordinarily, no doubt, all five of them, and others, enter in to decide the resultant behavior. But as one or another will predominate, or be consciously emphasized, I think the classification I have just given is legitimate for my present purpose.

Now, out of this complicated make-up of "morality," where is any solid ground to be found, on which the socially-minded individual can take a stand?

Instinct is unsafe, for an act based on impulse is quite as likely to be immoral as to be moral. The social evolution of man has progressed, in the last million years, so much faster and farther than the evolution of his inherent make-up, that he has far outgrown, so to speak, his native equipment, which in many cases, in civilized society, is more harmful than helpful.

Custom is valuable to a certain extent, as embodying part of the experience of the race. On the other hand, it is bound always to lag a little behind progress, which leads the young and impetuous to scoff, sometimes justifiably, at the restraints of "conventionality" as old-fashioned. Moreover, custom has varied so widely, the moral act in one nation or period being disgusting or outrageous in another, that custom has no great claim to sanctity. Our own forefathers not long ago thought it a sacred duty—or perhaps privilege—to murder those who differed from them on questions of dogmatic theology; while peoples with a rather high type of culture have considered it moral to put to death their own infants, to steal, to support prostitution as part of their religion, and to practice almost all the other crimes and vices of which a conference on social work can take cognizance.

Divine revelation is no longer a sufficient guide for many thoughtful people.

Conscience, for such reasons as I indicated above, is but a will-of-the-wisp.

THE PLACE FOR INTELLIGENCE

It is obvious, I think, that only in intelligent analysis of a situation is to be found any sound basis for morality. I do not wish to be thought to overrate the possibilities of intelligence. The human mind, at best, is a feeble and imperfect instrument. Even when provided with the best of principles, it too often goes wholly astray. The reasoning powers of the mind are all too often devoted solely to inventing a plausible justification for what the so-called instincts have already led their possessor to do. It is of primary importance that the intelligence, such as it is, have sound principles on which to act. Of the many bases from which philosophers have tried to derive a rational morality,[3] but one stands, in the last analysis, as unimpeachable. The survival, and improvement, of the race or group, is the one end to which others must, if necessary, be subordinate. Conduct which leads to the deterioration, or extinction, of the group which practises it, can only be considered evil conduct. A good, righteous, worthy, or social act must, therefore, be one that tends to favor the survival of the group or race. Here, it seems to me, is the sound basis for morality; and I therefore accept, as the most useful of the various conceptions current, the definition of morality as

[3] The types of moral theory may be classified as absolute and relative. The first type, exemplified by the doctrines of Immanuel Kant, supposes that there are certain "eternal and immutable" principles of conduct (which, in the opinion of most of the absolutist philosophers, are intuitively perceived). The relativists measure the value of an act by its consequences. The best-advertised of the relativistic theories is Utilitarianism, expounded enthusiastically by Jeremy Bentham, John Stuart Mill, and many other able men a century or less ago, with "the greatest happiness of the greatest number" as a campaign cry.

Or types of moral theory may be classed as intuitional and empirical. The former listens for the guidance of an "inward monitor" or "still, small voice"; the latter bases its judgments on the experience of how an act "works."

The theory which I am here upholding is of course to be classed as relativistic and empirical.

conduct that tends toward the progressive evolution of the human species.

In the light of this definition it is clear that, theoretically at least, there can be no such thing as unmoral, in the sense in which the word is currently used. Some acts, indeed, may have no appreciable bearing on morality, one way or the other; but they are less numerous than one might suppose at first thought. Usually the balance must fall on one side or the other. One often hears a person (usually, as it happens, a person of immoral conduct) apologetically described as "simply unmoral." This is absurd. The person may not have sense enough to know whether his or her acts are moral or the reverse; but either moral or immoral they must certainly be.

PREDICTING THE CONSEQUENCES

As to whether a given act is in effect moral or immoral, the consequences obviously must decide. These naturally can not actually be seen in advance; there are, therefore, two ways of determining whether an act is moral or immoral:

(1) Retrospection, to see how similar acts under similar conditions have resulted in the past. The "verdict of history" is to some extent crystallized in the mores or "conventional morality" of a people, but at best, as I pointed out, this is useful only to a limited extent, because conditions are always changing.

(2) Analysis, by which in imagination one deduces what the consequences of an act are likely to be. This is, of course, possible only to a fairly high order of intelligence. But it also takes a good deal of intelligence to interpret correctly the lessons of history. Indeed, some pessimist has said, "the only lesson history can teach us is that it has no lesson to teach."

If my premises are sound, it follows that an individual who voluntarily and regularly lives morally, must be intelligent. Morality is from this point of view a function of intelligence. One may, of course, be led or forced into a straight path by others; but such an individual can not be expected to stay in the path any longer than he feels the pull of the halter-rope. Hence the morality most desirable must be admitted to be that which represents the reflective conduct of an intelligent population.

The point I desire particularly to make, then, is that so far as a man acts morally, and knows what he is doing—so far as he is a conscious and controlling agent of his own destiny—he must act intelligently;[4] he must be guided by his own reasoning ability applied to such data as he can collect, and to his own critical evaluation of the reasoning of other individuals on similar problems.

This close relation between intelligence and morality is not merely a matter of logic, but of observed evidence. Statistical researches such as that of Frederick Adams Woods[5] have shown it to be a fact that intelligence and morality go hand in hand. That immorality and lack of intelligence also go hand in hand can be observed by any who studies delinquency. The dependence of these two conditions on each other is capable of more or less precise measurement, so that to a marked extent a man's intelligence can be predicted by measuring the morality of his conduct, and vice versa.

INTELLIGENCE THE KEY

Good conduct is usually thought of as the product of at least three factors:

[4] I do not wish to be understood as attributing to "reason" what it can not accomplish. Action must be the outcome of feeling rather than reason; and the emotions, impulses, and urges, which are, too often, almost independent of reason, are in many connections of paramount importance. Brevity compels me to omit any consideration of them here. In any case—to speak figuratively—it is reason which must decide a disputed point, even though the decision of reason must be carried into effect through some driving power in the mind. Moreover, there is in any community plenty of emotion to meet all requirements. It is reason that is most often lacking, and which I have therefore chosen to emphasize on this occasion.

[5] Woods, Frederick Adams, *Mental and Moral Heredity in Royalty*, New York, 1906. See also Popenoe, Paul, "Will Morality Disappear?", Journal of Heredity, ix, p. 269, Oct., 1918.

intelligence, emotional control, and environment. This offers no contradiction, for these qualities are positively correlated with each other. Though many individual exceptions will come to mind, it may be taken as certain that on the average the more intelligent man will be more able to control, not only his emotions, but also his environment. It is fair, therefore, to pick out intelligence as the key.

Now if anything is well demonstrated, it is that intelligence depends primarily on heredity: that unless one is born to become intelligent one can never become so. Education is, of course, necessary, but something to educate is a prerequisite. Fundamentally, the only way in which the United States as a nation can attain to a higher permanent level of morality, is to contain more intelligent people. And the only way of reaching this condition is by such changes in the birth-rates of different parts of the population as will make the most intelligent families produce more children, and the mentally defective stop reproducing—in a word, by eugenics.

RYE-WHEAT AND WHEAT-RYE HYBRIDS[1]

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and

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CROSSES between wheat and rye are rare and difficult to make owing to the tendency to come sterile but after seven years' work at the Washington Agricultural Experiment Station reciprocal crosses of these two species have been obtained. This marks a new step in plant breeding work, as a cross in which rye was used as the mother parent has never been reported so far as the writers are aware. Several crosses between wheat and rye in which wheat was used as the female parent have been obtained by other investigators. Leighty[2] reports the work done by Carman about 1880, by which several crosses of wheat and rye were secured. All of these possessed a high degree of sterility and in the words of Carman, "The trial finally came to an end on account of the absolute barrenness of the latest progeny." Leighty also reports[3] the occurrence of several natural wheat-rye hybrids which were found at the Arlington Station and elsewhere. These resembled wheat in their general appearance but were intermediate to wheat and rye in such characters as head length, pubescence of peduncle, size of culm, thickness of culm, density of the pith, and shape and size of glumes.

McFadden[4] reports the production of two wheat-rye hybrids which were wheat-like in appearance and sterile to a high degree. Backhouse[5] states that wheat-rye hybrids can be obtained more readily with some varieties of wheat than with others and that "crossability" is heritable in the varieties

[1] Contribution from the Agricultural Experiment Station, State College of Washington, Pullman, Washington.

[2] Leighty, Clyde E. 1916. Carman's wheat-rye hybrids. JOURNAL OF HEREDITY *7:* 420-427.

[3] ——————— 1920. Natural wheat-rye hybrids of 1918. JOURNAL OF HEREDITY *11:* 129-136.

[4] McFadden, E. A. 1917. Wheat-rye hybrids. JOURNAL OF HEREDITY *8:* 335-336.

[5] Backhouse, W. O. 1916. Note on the inheritance of "crossability." *Journal of Genetics 6:* 91-94.

studied. Love and Craig[6] report a number of wheat-rye crosses most of which were completely sterile in the F_1. They discuss, however, a wheat-rye hybrid which gave one seed in each of the F_1 and F_2 generations. The F_3 plant was more wheat-like than the F_1 or F_2 and did not show its hybrid nature to any great extent. It produced many seeds from which an F_4 generation was grown. The plants of this F_4 family were variable and seemed to segregate according to a simple Mendelian ratio of 3:1 with respect to color of chaff, beards and color of kernel. A difference in sterility was also exhibited in this generation, some of the plants being completely fertile and some nearly sterile. The F_2 plant was bearded. The F_3 plant was not illustrated, but the authors state that it was more wheat-like than either the F_1 or the F_2 plants. The bearded habit in cereals is generally recessive. The F_3 and later families should, therefore, have all been bearded like the F_2 plant, but in the illustrations, approximately three-fourths of the F_4 plants were beardless. If the lone seed which was produced by the F_2 plant had been the result of cross-fertilization with wheat, the result in the F_4 generation would be expected. The increased fertility of the F_3 plant also adds weight to the supposition that a natural or accidental back cross with wheat might have occurred in the F_2, to produce the wheat-like F_3 plant.

Besides the American investigators mentioned above much work has been done by European plant breeders in attempting crosses between wheat and rye, but with the same general type of results.

HYBRIDS MADE AT PULLMAN, WASH.

The work with wheat-rye hybrids at the Washington Agricultural Experiment Station was begun in 1915 but no fertile F_1 plants were obtained until Rosen was used as the rye parent in 1919. This rye was introduced into Michigan from Russia in 1909. It is so prolific that Spragg[7] reports that it has crowded out wheat in certain sections of Michigan. It is more compatible with wheat than any other rye worked with at this station, and is unique in that partly fertile F_1 plants were obtained when it was used either as male or female parent. During the first four years various rye crosses were tried with different wheats and even barley and rye crosses were attempted. A number of seeds were obtained but most of them did not grow. The few that did grow were fully fertile and exactly like the female parent, the flowers apparently having been selfed in the operation of hybridizing. With Rosen rye it was different. Seven crosses made with this rye produced 44 seeds from which only 8 plants were obtained that showed unmistakably their hybrid origin, that is, they were intermediate. Four of these crosses were rye-wheat, that is, rye was the female parent, and three were wheat-rye, that is, wheat was the female parent.

FIRST GENERATION OF RYE-WHEAT HYBRIDS

The four rye-wheat hybrids were obtained with Rosen as the female

TABLE 1. *Showing the number of flowers treated, number of seeds set, number of F_1 plants and number of F_2 plants*

Name of hybrid	No. of flowers treated	No. of seeds set 1919	No. of F_1 plants 1920	No. of F_2 plants 1921
Rosen × Fortyfold	46	5	0	0
Rosen × Jenkin	22	10	1	7
Rosen × Jones Fife	22	8	1	27
Rosen × Hybrid 128	18	13	4	143

[6] Love, H. H. and Craig, W. T. 1919. Fertile wheat-rye hybrids. JOURNAL OF HEREDITY *10:* 195-207.

[7] Spragg, Frank A. 1921. Rosen Rye. Michigan Agr. Exp. Sta. Special Bulletin 105: 1-11.

PARENTS AND SECOND GENERATION OF WHEAT-RYE HYERIDS

The resemblance to the female parent, Rosen rye (1) is evident. The male parent, Hybrid 128 (4) is extremely susceptible to bunt, while rye is nearly immune. The hybrid plants were sometimes affected, and (3) shows a bunted head of the hybrid. In view of the finding of completely bunted heads of rye this does not necessarily indicate the inheritance of a male characteristic. (Fig. 17.)

parent and four wheat varieties Fortyfold, Jenkin, Jones Fife and Hybrid 128 as male parents. Table 1 gives the performance data for all four of these hybrids for the years 1919, 1920, and 1921.

A comparatively high percentage of the flowers treated set seed but very few of these produced F_1 plants. The five seeds of Rosen × Fortyfold resembled rye in general appearance but were badly shrunken and all failed to produce F_1 plants. The taxonomic characters of the F_1 plant of Rosen × Jenkin were very much like those of rye but were slightly modified by the wheat parent. It was evident from these modified characters and from the 95 percent sterility displayed that this was a true F_1 plant. The same might be said of the appearance of the F_1 plant secured from Rosen × Jones Fife but this was slightly more fertile. Four F_1 plants of Rosen × Hybrid 128 were also secured. These again did not differ greatly from rye in their botanical characters but they all exhibited a high degree of sterility which varied with the individual from 75 percent for the most fertile one to 90 percent for the one highest in sterility.

SECOND GENERATION OF RYE-WHEAT HYBRIDS

The character which showed the greatest variation in the F_2 was the degree of fertility. This ranged from complete sterility to complete fertility with an average of 50 percent. The average fertility is much greater than that shown in the F_1 generation, as the F_1 plants were all in class 1. (See below.)

The data on fertility are shown in table 2 which gives the distribution of the differing characteristics of the parent plants and their F_2 hybrids. The method of obtaining the data was as follows: the plants were pulled and brought into the laboratory where an estimate of the fertility was made by passing the heads of each plant through the fingers. After a little practice one can readily tell whether the floral glume contains a seed or is sterile. The plants were arbitrarily thrown into five classes. Class 4 represents as complete fertility as is normally found in wheat, class 0 represents complete sterility and classes 1, 2 and 3 represent degrees of fertility approaching one-fourth, one-half and three-fourths respectively. With the exception of the wide variation in fertility the F_2 plants

TABLE 2. *Distribution of the differing characteristics of the parent plants and their F_2 hybrids in the rye-wheat crosses*

Number		Number plants analyzed	Plant height av. cms.	Head length av. cms.	Purple straw percent	Pubescent peduncle percent	Hollow culm percent	Fertility (a) No. plants in each class 0	1	2	3	4
1940	Rosen rye	41	137	11.7	0	66	15	0	0	10	19	12
526	Jenkin.............	(b)	109	5.1	0	0	100	0	0	0	0	All
371	Jones Fife..........	(c)	99	10.9	0	0	100	0	0	0	0	All
592	Hybrid 128.........	(c)	104	4.6	0	0	100	0	0	0	0	All
3905	Rosen×Jenkin......	7	124		0	57			(d)	(d)		
3915	Rosen×Jones Fife...	20	127	11.2	90	60			"	"		
3911	Rosen×Hybrid 128..	70	114			46			"	"		
3912	"	15	112	9.4		67	27	1	5	2	5	2
3913	"	19	119	10.9	37	68	21	1	6	8	3	1
3914	"	20	122	10.9	15	70	55	1	4	4	8	3

(a) The degree of fertility was arbitrarily divided into five classes, class 4 represents as complete fertility as is normally found in wheat, class 0 represents complete sterility, and classes 1, 2 and 3 represent a degree of fertility approaching one-fourth, one-half and three-fourths.

(b) 3 year average.

(c) 10 year average.

(d) No record.

PARENTS AND SECOND GENERATION OF WHEAT-RYE HYBRIDS

Turkey wheat (1) and Rosen rye (4) with the hybrid forms between. Both parents are very resistant to bunt, and both are bearded. The hybrid heads are beardless and one of them (2) is bunted. (Fig. 18.)

SECOND GENERATION HYBRID RYE-WHEAT TYPES

The dominance of the maternal parent is evident. Hybridization in this case has resulted in a high degree of sterility. Carman's original experiments with this cross were brought to a close "on account of the absolute barrenness of the latest progeny." (Fig. 19).

TYPES OF WHEAT-RYE HYBRIDS

All wheat-like in appearance. Some of the other characters were intermediate, but one almost questions whether these are crosses in the usual sense of the word, or whether the male element may not have initiated development without conjugation. In generic crosses the genetic mechanism of the cell is often seriously upset in a way that is not very well understood. (Fig. 20.)

were very rye-like, especially with respect to such characters as beards, ciliation and shape of the lemmas. They were bearded in spite of the fact that all the wheat parents were beardless, but the beards in some cases were much shorter than those on rye. The lemmas were all lanceolate in shape and possessed distinct ciliate keels with the exception of five plants in the cross with Hybrid 128 which showed a slight modification in this character, as they were ciliate only toward the tips.

The fourth column of table 2 shows that the average plant height of each cross is intermediate to its parents. The low extreme approximates wheat and the upper extreme approximates rye in height. The average head length of the four F_2 families analyzed is shorter than rye but longer than the wheat parent in each case. The heads of family number 3912 averaged one and one-half centimeters shorter than its three sibs. Its shortest heads were but little longer than the longest heads of Hybrid 128. The striking contrast in head length is shown in figure 17 which represents a head of each of the parents with two of the F_2 segregates between. This shows the rye (female) to be nearly three times as long as the wheat (male). The F_2 types are intermediate in length. The one to the right is infected with *Tilletia tritici.* The extremes in head length and fertility are illustrated in figure 19.

Ninety percent of the F_2 plants of Rosen × Jones Fife had purple straw although the wheat and rye that went into the cross both have white straw with no indication of purpling in leaf-sheath or internode. The appearance of color evidently comes from the unusual recombinations of rye and wheat chromatin. This purpling of the straw, especially in the upper internode also appeared to a less degree among the F_2 plants of Rosen × Hybrid 128. No purpling appeared in the F_2 family of Rosen × Jenkin.

Number 3911 gave 46 percent of plants with pubescent peduncles which is lower than that found in the rye parent but the percentage in all the other families was very similar to the variation in Rosen. In the F_2 families of Rosen × Hybrid 128 a higher percentage of hollow culms was found than in the rye parent.

The plants in number 3914 not only contained hollow culms up to the base of the heads in more than one-half of the plants, but the neck immediately below the head was thicker and stiffer and more like that of wheat. None of these segregations give a simple unit character ratio but the variations show a recombination of the characters of wheat and rye with those of the female parent predominating.

FIRST GENERATION OF WHEAT-RYE HYBRIDS

Maternal dominance is shown again in the wheat-rye hybrids. The general appearance of the two F_1 plants of Turkey × Rosen was very much like that of wheat, but they could be readily distinguished as true F_1 plants by the high degree of sterility. One plant produced 24 completely sterile heads and 6 that were partly sterile, the other produced 13 sterile and 10 partly sterile heads.

SECOND GENERATION OF WHEAT-RYE HYBRIDS

That the chromatin material was disarranged when the recombination took place is shown by the plant characters in the F_2 generation. Nine of the 15 plants were beardless although Turkey and Rosen are both bearded. The wheat chromosome carrying the gene for beards might have been eliminated in the first hybrid seed. The rye gene for beards recombining in the F_1 generation would then produce beardless and bearded plants in the F_2 in the ratio 3:1. This hypothesis could also be used to explain the unusual results obtained by Love and Craig.

Hybridization under normal conditions increases fertility but in this cross only one plant showed normal fertility. Two others were 50 percent sterile, two 75 percent, six from 90 to 98 percent and three completely sterile.

Each of the characters, pubescent peduncle and solid culm, seemed to be

inherited from the rye as a unit character, as the ratio for each is as close to 3:1 as could be expected with the small number of plants. The data for these characters are given in the following tabulation:

11 pubescent peduncles	4 glabrous peduncles
12 hollow culms	3 solid culms

Figure 18 shows Turkey and Rosen with two of the F_2 segregates between. Number 2 represents a head from a smutted plant and number 3 one of the partly sterile beardless types. Figure 20 shows a representative head from each of the F_2 types.

BUNT ON RYE

Bunt was found this past season on Common rye, on an F_2 plant of Rosen × Hybrid 128 and on an F_2 plant of Turkey × Rosen. It is a common pest in this country but its attacks were thought to be limited to the genus Triticum. The occurrence of a totally bunted plant in each of the F_2 generations seemed to indicate the genetic relationship of the parents, but when later in the season two totally bunted heads of common rye were discovered in the variety test plots this hypothesis did not seem quite so conclusive.

DISCUSSION AND SUMMARY

Generic crosses are fairly common in the literature and many show a considerable degree of fertility. Wheat and rye are considered on the borderland, representing the widest cross among cereals that may be made and yet recover fixed segregates in later generations. In fact, it is questionable whether truly intermediate segregates can be so obtained, for all the wheat-rye hybrids reported thus far have been decidedly wheat-like by the time they reached the homozygous conditions of their principal taxonomic characters. Similarly, the rye-wheat crosses reported herein are all rye-like in the F_2, and it may reasonably be supposed that the variations in subsequent generations will be in the direction of the maternal rye progenitor. Rosen rye seems so much more compatible in crossing with wheat than other varieties that the question arises as to whether it may not carry a different complement of chromosomes. We have been able to cross it with Jenkin, Hybrid 128 and Jones Fife wheat and to obtain F_1 plants that were not entirely sterile even when Rosen rye was the female parent. This is a feat never accomplished with any other rye at this station and is the first recorded instance of a rye-wheat cross insofar as the writers are aware. From the three crosses 7, 143 and 27, F_2 plants respectively were produced in the season of 1921. They were all rye-like in appearance resembling the maternal parent strongly, and a few of them exhibited as high a degree of fertility as Rosen rye.

One wheat-rye cross was obtained with Turkey wheat as the female parent and Rosen rye as the male parent. The Rosen pollen did not stamp the rye characteristics on the F_1, or F_2 progeny to any great extent, but the abnormality and barrenness of the plants showed a violent upsetting of normal metabolism. The four wheats used in the crosses with Rosen rye are all fertile inter se. The wheat-rye cross gave progeny which were all wheat-like. The rye-wheat crosses gave progeny that were all rye-like. Thus in every case only matroclinous hybrids were obtained. Although reciprocal crosses with the same wheat variety were not obtained, it seems, reasoning from analogy, that if such had been secured they would have been very different. This is very unusual and may have a cytological basis, for the wheats according to Sax[8] have 21 chromosomes (haploid) and Rosen probably has 7.

Turkey is very resistant to bunt, seldom producing more than five percent of bunted heads even when the seed is blackened with viable spores. The occurrence of a completely bunted plant in the F_2 generation of Turkey × Rosen, therefore, came as a surprise for it would scarcely have been expected

[8] Sax, Karl. 1921. Chromosome relationships in wheat. Science N. S. *54:* 413-415.

in the wheat parent, much less on rye. It has often been noticed that certain segregates in wide crosses of different species of wheat are much more predisposed to stem rust and yellow rust than the parents.

One plant in the F_2 of Rosen × Hybrid 128 was also found to be infected but since the Hybrid 128 parent is very susceptible to bunt, infected plants might be expected in this cross.

Whether any new strain of commercial value can be developed from very wide crosses is a debatable question. To the writers such crosses seem freighted with possibilities. If, however, matroclinous hybrids are the rule the variation in form might be limited, but in the final recombinations of compatible chromatin new forms unlike anything ever seen before are possible. In the creation of the new, might not a form appear more desirable for the purposes of man than anything now in existence?

A NEW SPECIES OF MAN FROM AFRICA

While the anti-evolution propaganda grows in the southern states ardently championed by an ex-Secretary of State, the fossil bones of a new member of the human species have been uncovered in Rhodesia. This new find has been the occasion of some discussion as to its antiquity and the salient features are ably presented in the *Atlantic Monthly* by Dr. G. Elliot Smith.[1] The bones are heavily encrusted with salts of zinc and lead but are not mineralized or strictly fossilized. They were found at the Broken Hill Mine in northern Rhodesia, about 300 miles north of Zambezi, and constitute the first important discovery of prehistoric man in the African continent. This new member of the human family has been designated *Homo rhodesiensis* and takes its place with *H. neanderthalensis* and *H. heidelbergensis* in the evolutionary ladder of *H. sapiens*, occupying a position in development intermediate between *H. neanderthalensis*, the lowest member of the genus Homo hitherto recognized, and *Eoanthropus dawsoni* and *Pithecanthropus erectus* the two most primitive forms of the human family, so primitive in fact that many palaeontologists still regard *Pithecanthropus* as an ape and the jaw of *Eoanthropus* as that of a chimpanzee. The form of the brain-case and the peculiarly distinctive features of the brain that it once contained leads Dr. Smith to believe that this Rhodesian species is the most primitive member of the genus Homo at present known, but not the most primitive of the human family.

He calls attention to the fact that even the lowly *Pithecanthropus* possessed the power of articulate speech which had reached an even higher stage of development in *Eoanthropus* while *H. rhodesiensis* lies between *Eoanthropus* and *H. neanderthalensis* in this respect.

There is still a question as to whether the Rhodesian man walked upright instead of with the bent-kneed locomotion of the Neanderthal man and, if so, how he can be considered more primitive than the latter, but Dr. Smith directs attention to the fact that *Pithecanthropus* walked erect though admittedly the most ancient and primitive member of the human family.

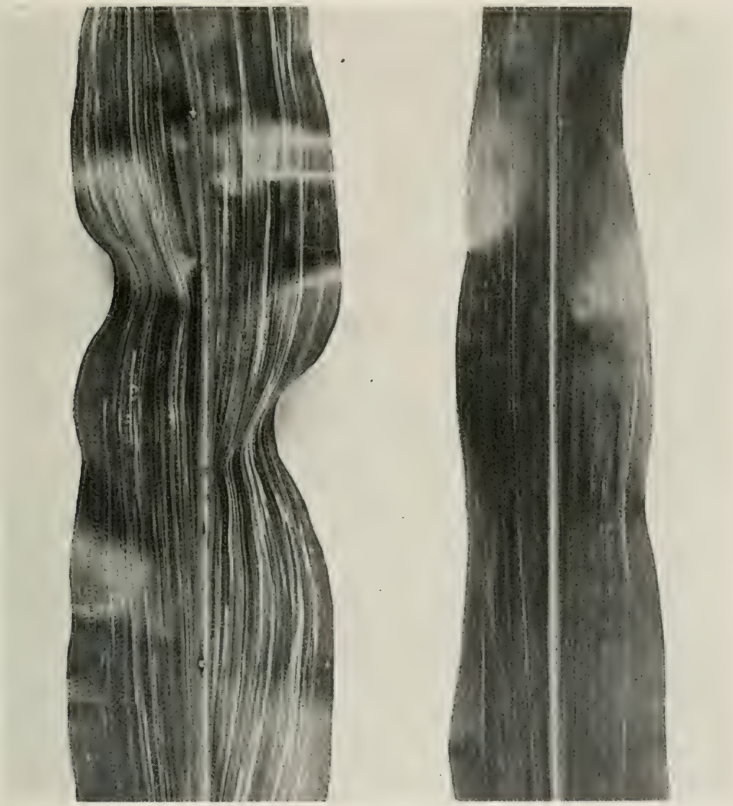
He is careful to state that while the evidence may favor the hypothesis that *H. rhodesiensis* walked erect it cannot be concluded from this that Rhodesian man was post-Neanderthal since even *H. sapiens* possesses some features more primitive than those of Neanderthal man.—J. H. K.

[1] Smith, G. Elliot. The Fossil Man of Rhodesia. *Atlantic Monthly*, pp. 454-465, April 1922.

HERITABLE CHARACTERS OF MAIZE

XI. FINE-STREAKED LEAVES[1]

E. G. Anderson



FINE-STREAKED MAIZE LEAVES

These leaves are characterized by a few fine white streaks as shown on the left, although occasional plants are found in which the streaks are more frequent and more prominent. Apparently the inheritance of this character is closely linked with the factor for the inheritance of white endosperm as no streaked plants were produced from yellow seeds. (Fig. 21.)

IN A NUMBER of cultures of maize grown in 1917, plants were found with finely streaked leaves. Records showed these cultures to be closely related. A few fine-streak plants were selfed and found to breed true. Outcrosses with unrelated normal green plants gave only normal green F_1 plants. Fine-streaked segregates were obtained in F_2, though usually less than 25 percent. These varied from prominently streaked to very faintly streaked or almost pure green plants. Backcrosses with fine-streak have likewise given less than 50 percent fine-streaks.

Fine-streak was first observed in cultures free from yellow endosperm. Crosses made involving yellow endosperm were backcrossed to the double recessive (white endosperm fine-streak). The yellow seeds when planted gave

[1] Paper No. 100, Department of Plant Breeding, Cornell University, Ithaca, New York.

FINE-STRIPED MAIZE LEAVES

They differ from the fine-streaked leaves shown in figure 22 in having the light streaks principally near the margins of the leaves. Crosses of this type with the fine streaked corn gave normal green plants in the first generation. (Fig. 22.)

about 100 plants, all normal green, whereas the white seeds gave a large number of fine-streaks. From similar backcrosses made later, 253 normal green plants were grown from yellow seeds, no fine streaks being obtained. The character "fine-streak" seems to be dependent upon a factor closely linked with the factor pair *Y y* for yellow *vs.* white endosperm. The failure to obtain more than about 50 percent of fine-streaks from the white seeds of the backcross may be due to a second factor necessary for fine-streak or may be due to the difficulty of distinguishing the fine-streak character from normal green.

Fine-streaked plants are characterized by narrow light streaks on the leaf blades. Usually only a few faint streaks are to be found, but occasionally plants are found with prominently streaked leaves (Fig. 21). There is some resemblance to the lineate leaved type described by Collins and Kempton,[2] but the light streaks are much fewer, coarser, and irregularly placed. It differs from Lindstrom's[3] fine-striped type (Fig. 22) in having the light streaks scattered throughout the leaves instead of being largely concentrated near the margins. Crosses of fine-streaked with fine-striped gave normal green F_1 plants.

[2] Collins, G. N. and Kempton, J. H. Heritable Characters of Maize: Lineate Leaves. JOUR. HEREDITY 11: 3-6, 1920.

[3] Lindstrom, E. W. Chlorophyll Inheritance in Maize. Cornell Univ. Agr. Exp. Sta. Memoir 13: 1-68, 1918.

THE SCIENCE AND PRACTICAL APPLICATION OF EUGENICS

By Harry H. Laughlin
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Cold Spring Harbor, Long Island, N. Y.

I THE SCIENCE OF EUGENICS

THE essential idea of eugenics, that is, the conservation of specific family qualities, and the improvement of the hereditary endowments of a nation or race as a whole, by better breeding, is as old as civilization, both as an ideal and a practice; but the discovery and systematic coordination of the principles of biology and social organization which govern family and racial fortunes, is a relatively recent achievement. Within the last generation, scientific methods of observation, experimentation, tabulation and analysis have been applied to the family and racial fortunes of mankind, with the result that a definite and well systematized body of rules is being developed. Sir Francis Galton,[1] the centenary of whose birth is observed this year (1922), formulated the basic elements which justify calling eugenics a science. He applied the scientific method to his studies and was rewarded by finding that his analyses yielded not only demographic generalizations, but also biological principles. He is properly looked up to as the founder of the science.

Eugenics, like most other real things, existed before it was named. While preparing material for his first great work in eugenics, "Hereditary Genius," which appeared in 1869, Galton published his preliminary studies in this field in two papers in "Macmillan's Magazine" under the title "Hereditary Talent and Genius." They appeared in 1865—six years after his half-cousin,[2] Charles Darwin, had published "The Origin of Species." Although in Galton's earlier books and papers, the word 'eugenics' does not occur, these works constitute the first scientific publications on the subject. Galton continued his researches, and in 1883, in his book on "Inquiries into Human Faculty and Its Development," the word 'eugenics' appears (Second edition 1907, Reprint of 1911, p. 17) as the name of the systematized knowledge with which he had been working. In this book, Galton announces, as follows, the coinage of the word, and says concerning his research:

> "Its intention is to touch on various topics more or less connected with that of the cultivation of race, or, as we might call it, with 'eugenic' questions, and to present the results of several of my own separate investigations."

In this statement the word 'eugenic' is noted for reference at the foot of the page, where the following explanation appears:

> "That is, with questions bearing on what is termed in Greek, *eugenes*, namely, good in stock, hereditarily endowed with noble qualities. This, and the allied words, *eugenea*, etc., are equally applicable to men, brutes, and plants. We greatly want a brief word to express the science of improving stock, which is by no

[1] Francis Galton was born near Sparkbrook, Birmingham, England, February 16, 1822. He was graduated by Trinity College, Cambridge, in 1844, and received the knighthood in 1909. His death occurred at Haslemere, Surrey, January 17, 1911.

[2] Both Sir Francis Galton and Charles Darwin were grandsons of Dr. Erasmus Darwin (1731–1802), physician, poet, naturalist and philosopher. Charles Darwin was the son of Dr. Robert Darwin, whose mother was the first wife of Dr. Erasmus Darwin. Francis Galton was the son of Samuel Tertius Galton and F. A. Violetta Darwin, the latter a daughter of Dr. Erasmus Darwin by his second wife. To Francis Galton, the Darwin ancestral blood contributed a love of nature and of philosophic interpretation. As evidence, note that in 1794–6 the maternal grandfather, Erasmus Darwin, published "Zoonomia, or the Laws of Organic Life." From the Galton side came a love for statistical analysis. Both the father, Samuel Tertius Galton, and the grandfather, Samuel John Galton, were "scientists and statisticians by inclination." Galton suggests that the exceptional longevity that he, his brother and sisters and his mother enjoyed, came from "grandmother Darwin (1747–1832)," the second wife of Dr. Erasmus Darwin, who, before marriage to Dr. Darwin, was the widow of Colonel E. Sacheverel Chandos-Pole.

means confined to questions of judicious mating, but which, especially in the case of man, takes cognizance of all influences that tend in however remote a degree to give to the more suitable races or strains of blood a better chance of prevailing speedily over the less suitable than they otherwise would have had. The word *eugenics* would sufficiently express the idea; it is at least a neater word and a more generalized one than *viriculture*, which I once ventured to use."

Eugenics, like other sciences, draws heavily upon related bodies of knowledge and methods of study. While it seeks aid from allied sciences and is, in turn, called upon by them, its own special and borrowed knowledge is so systematized that it is entitled to a place of independent recognition. Indeed this independence on the one hand and this inter-dependence on the other is, paradoxical as it may seem, a characteristic of every science, no matter how highly specialized or how old it may be.

A reproduction of the certificate which was awarded by the President and the Committee on Exhibits of the Second International Congress of Eugenics to persons who exhibited eugenical material of merit at the Congress, appears on an accompanying page. The figure[3] at the top shows graphically the relation of eugenics to its allied sciences. It shows that particularly genetics, anthropology, statistics or demography, and genealogy and biography contribute great quantities of facts and principles to eugenics.

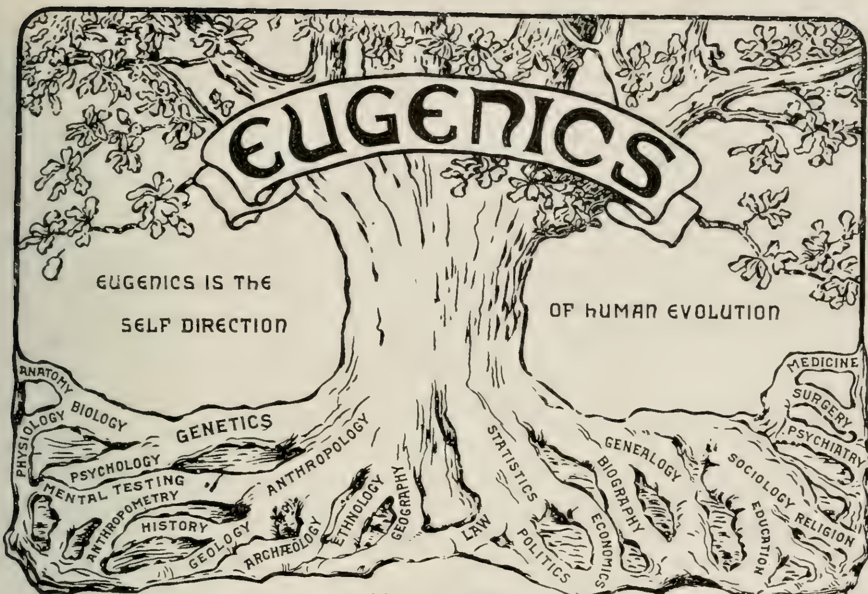
All metaphors have their limitations, but this one of the tree is correct to the extent of indicating that the substances drawn from the roots are reorganized and assimilated. It is improper to designate eugenics as subordinate to any one of its three or four principal contributory sciences, such as genetics or demography, or to any of the score of essential but less quantitatively contributing sciences. If, however, one were to construct a similar diagram showing education, statistics, genetics, history, medicine, psychiatry or other allied science or system as a tree, it would be necessary to show eugenics as constituting a root of considerable importance. This reminds us that all groups of knowledge are interwoven, and that each science secures its material from two sources, first, selectively from the whole mass of human knowledge and the known laws of nature, and second, by research into problems distinctively its own.

II THE PRACTICAL APPLICATION OF EUGENICS

Eugenics is the self-direction of human evolution. By its study, mankind seeks to find out the laws that govern the direction of human evolution. By its practical application, each of the several nations which constitute the species *Homo sapiens*, strives to direct its own evolution along those lines which seem to it most profitable. It is commonly agreed, for our own nation at least, that this family development of inborn traits must be along the lines, principally, of greater hardihood, longer period of individual efficiency, greater output of energy,[4] higher intellectual level, more highly specialized talents, finer social and moral adjustments, and with all a better natural balance of these qualities within the individual. The principal basis for confidence in eugenics as a practicable thing is derived from the success which mankind has had in directing the evolution of domestic races of plants and animals. Man is

[3] The plan of this diagram is the working out schematically of the substance of a paper on the "Relation of Eugenics to Other Sciences." (H. H. Laughlin, the *Eugenics Review*, London, July, 1919.) The drawing was made by Miss Alice M. Hellmer.

[4] Concerning human energy, Galton writes, "Energy is the capacity for labour. It is consistent with all the robust virtues, and makes a large practice of them possible. It is the measure of fulness of life; the more energy the more abundance of it; no energy at all is death; idiots are feeble and listless. . . . Energy is an attribute of the higher races, being favoured beyond all other qualities by natural selection. . . . In any scheme of eugenics, energy is the most important quality to favour; it is, as we have seen, the basis of living action, and it is eminently transmissible by descent." ("Inquiries into Human Faculty and Its Development," pp. 17, 18, 19. Second edition 1907, Reprint of 1911.)



LIKE A TREE
EUGENICS DRAWS ITS MATERIALS FROM MANY SOURCES AND ORGANIZES THEM INTO AN HARMONIOUS ENTITY.

The Second International Congress of Eugenics, devoted to researches in all fields of science and practice which bear upon the improvement of racial qualities in man, convey this expression of appreciation of the display of a file of the

Journal of Heredity

which the American Genetic Association of Washington, D. C. has shown at the exhibition of the Congress at the American Museum of Natural History.

New York, September 1921.

Henry Fairfield Osborn — *President of the Congress*

Harry H. Laughlin. — *Chairman of the Committee on Exhibits*

an animal. The principal difference between plant and animal breeding and eugenics lies in the fact that the essential forces of race improvement—selective mating and elimination—which, in the one case, man applies to the lower species, in the other, he applies to himself.[5]

[5] Other differences between eugenics and breeding should not be overlooked. People not unnaturally resent and even oppose eugenics if they get the mistaken idea that eugenists are undertaking to control mankind as domestic animals are controlled. The chief object of plant and animal breeding is to produce large numbers of individuals as nearly alike as possible, by propagating from a single individual or a few select individuals, whereas eugenics relates to the general evolutionary improvement of the racial stock, with no idea of suppressing the normal individual diversity of talents, temperaments and physical features. Though the same general facts of inheritance, or "laws of heredity," must be taken into account in eugenics as in plant and animal breeding, the eugenic problems have to be worked out on entirely different lines. Racial progress will depend upon general information and education of the public to a state of eugenic consciousness and responsibility, which is not required for plant and animal breeding. For a statement at greater length, see "Eugenics and Breeding," by O. F. Cook in this Journal, Vol. 5, pp. 30-33, January 1914.—Ed.

A New Catalog of Plant Names

All workers with plants should be greatly interested in a publication that has been announced recently by the American Joint Committee on Horticultural Nomenclature. The work is entitled the "Official Catalog of Standardized Plant Names" and will include:

(1) The approved Scientific Names of plants in American commerce, and the Synonyms which have been most generally used for such approved names; (2) The approved Common Names of such plants where such names have been formulated, and important synonymous or unapproved common names; (3) Authoritative lists of Variety Names, in important classes, such as Rose, Iris, Peony, Dahlia, Lilac, Rhododendron, Chrysanthemum, Sweet Peas, etc.; (4) The approved variety names of Fruits, according to the newly revised code of the American Pomological Society.

Confusion regarding the use of common and varietal names has been a very real obstacle to progress in plant physiology and genetics. Not a few of the discrepancies in the findings of plant investigators are traceable to unsuspected differences in the basic material used, different plants not infrequently being sold under the same varietal name and the same variety under different names.

The Official Catalog should go far toward effecting stability in the use of common names. The choice of names has been made very carefully and the committee in charge of the work represents the leading seed and nursery organizations as well as those interested in the more technical aspects of botany. There can be little doubt that the usages sanctioned in this work will be adopted generally by the trade.

There is a widespread feeling on the part of plant breeders that new plant productions should be protected by patent. A carefully prepared and complete list of existing varieties is the logical first step in this direction.

For complete information and prepublication prices those interested should address Harlan P. Kelsey, Sec'y American Joint Committee on Horticultural Nomenclature, Salem, Mass.

A REQUEST FOR MULTIPLE-LEAVED CLOVER PLANTS

H. F. Roberts, Professor of Botany of the University of Manitoba, Winnipeg, Canada, desires to obtain plants of White Dutch Clover (Trifolium repens) and Red Clover (Trifolium pratense) bearing supplementary leaflets. He desires a series having different numbers of leaves to use in a Genetics experiment. If readers of the Journal of Heredity who find such plants would be so kind as to mail them to Prof. Roberts, it would be greatly appreciated.

The Journal of Heredity

(Formerly the American Breeders' Magazine)

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CONTENTS

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THE BREEDER AND HIS PRODUCT

Mr. N. A. Jones and one of his hybrid wheats. Men like Jones in New York and Etter in California are necessary for agricultural progress and prosperity, the basis of our civilization. Is it not just and expedient that a system of plant patents be perfected to protect breeders, and insure their reaping a sufficient reward from their lifelong labours to prevent pecuniary difficulties and other worries interferring with their work? See N. A. Jones—Plant Breeder, P. 103 (Frontispiece).

IS THE CHINESE HEREDITY INFERIOR?

CHO WANG
Cornell University, Ithaca, New York

ACCORDING to the view of most biologists the ultimate value and accomplishments of any people are determined by its heredity. The negro race has been accused of its relatively low mental ability and consequently its poor contribution to civilization. The white race is very proud of its heredity; geographical and other forces have been operating in favor of the showing up of its potential ability. The yellow race, especially the Chinese, has long been regarded as a mystery to the western people, and the value of its heredity is rarely understood.

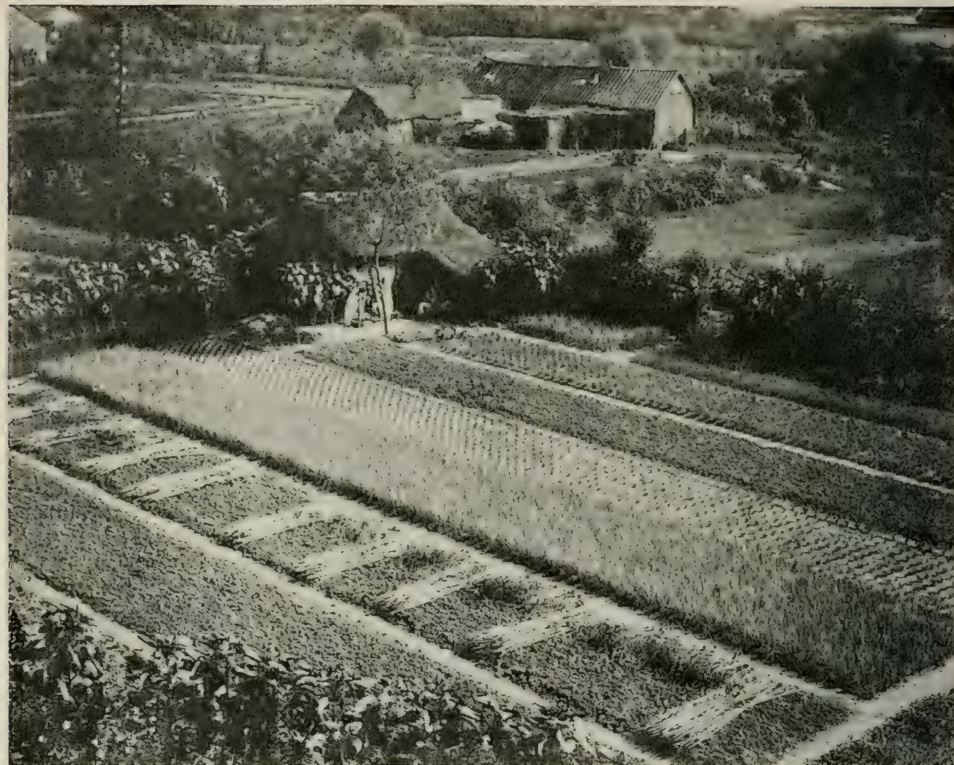
It is very interesting to note that many foreigners, especially Americans who have been observing and studying the Chinese for many years, have come to the conclusion that the Chinese are hereditarily very strong. Unfortunately this worthy idea is often overlooked or unknown to many—particularly to the Chinese. In order to accomplish any task the performer must have confidence in his ability, and a friendly, sympathetic understanding of others. A consideration of the Chinese heredity, therefore, is not only enlightening to the foreigner, but imperative to all Chinese.

One of the most accurate criteria with which to measure the heredity of a people is its historical accomplishment. Chinese history and civilization are the longest of the unbroken, living ones of the world, and who has the slightest doubt that they are due to heredity? The Emperor Hwang-ti invented the compass and his Queen the silk-worm culture long before Greece or Rome came into existence. One after another of such epoch-making inventions as gun powder, printing, and others were contributed to the world by the slant-eyed Chinese. These facts demonstrate clearly that the Chinese are not lacking in originality; if they had never accomplished anything else, they would be justified in being proud of themselves.

The writer is fully aware of the repeated accusations that the Chinese are a backward people. It is granted that the Chinese developed a high civilization in ancient times, but it is said that their heads are bent to the past, and that, consequently, progress decreased and finally changed to stagnation; and the glorious days of China are in the past. The writer does not deny that there was a slowing down movement starting about the Christian era, but he does deny that the condition may be termed "backwardness." The retardation of Chinese civilization was not caused by Chinese religion, philosophy, habit of thinking or any other already attributed agencies, but mainly by geographical isolation. During the Han Dynasty (85 B.C. to 327 A.D.) the Chinese had conquered all that was to be conquered, secured all their material desires within the boundaries of their Empire, and, above all, attained higher culture and civilization than all their neighboring states. Is it not human nature to "slow down," if a people are satisfied with what they have, with no fear of conquerors or competitors? Have not the Chinese been awakened during the last few decades by the influence of Westerners? Has the retardation of Chinese civilization anything to do with heredity?

A PHILOSOPHICAL PEOPLE

The Chinese are proverbially known as a moral people, so it is rather unnecessary to dwell any longer to prove that they are a superior people morally.



A CHINESE FARM

China is better known for her urban arts, many of which are parasitic in character, than she is for her agriculture. We do not often consider how her teeming cities and crowded market places are supplied with food. There are no large tracts of land cultivated as a unit, as is done under our extensive methods. Each farm is worked by the farmer and his family, who themselves do most of the work, as there are very few draft animals. This picture was taken from the wall of Nanking, looking toward the city. (Fig. 1)

Nevertheless all human minds need constant reminding, so a consideration of the "philosophical people" may here be made. For forty centuries the Chinese have been followers of their philosophy of peace and industry; they are always practising and preaching peaceful justice—a noble idea which was gradually recognized by the leading thinkers of the world. Their filial piety, friendship, loyalty, and amiable character are perhaps unsurpassed. But most foreigners are familar only with the Chinese merchants abroad, and consequently they draw misleading observations and conslusions. The writer does not mean to state that such merchants do not represent the Chinese, but he only wants to make it clear that they represent only one class of Chinese. Students of biology and sociology agree that city life is detrimental to human physique and morality, so there is no wonder that even the Chinese gamble or fight "tong wars." It must be remembered that most of them are deprived of home life, and have absolutely no such pleasure and refreshment under the category of "social life." Yet the Chinese merchants in the Philippines, Hawaiian Islands, the United States, or elsewhere on the globe, morally are second to none. It seems to the writer that the reason why the Chinese are often hated, despised and ridiculed by those who are not well

A GIANT CHINAMAN

This man is one of two gigantic brothers who are doorkeepers at the government experiment station northwest of Peking. He is very sensitive about his great size, and refused to be photographed, even the director's orders proving ineffective. When invited to stand for his picture with the director and the American visitor the giant was too polite to refuse. The other brother is somewhat shorter. While these men are of exceptional size, they nevertheless serve to remind us that there are many people of no mean stature in Northern China, particularly in the district in which these brothers were born. (Fig. 2.)

informed is simply this: That "man carries his bag of faults on his back"; he always sees the faults of others but seldom his own.

According to the reports of the missionary schools in China, and to the mental measurements of the Board of Education of the Hawaiian Islands, the average Chinese school child is just as able as the American. The high scholarship of the Chinese students in American colleges is well known; the writer had the pleasure to hear from one of his professors, "My Chinese students are always the best!" It is true that the Chinese have not yet made any great contribution to pure sciences, but this is due to a lack of scientific environment and not due to deficiency in heredity. Such prominent biologists and eugenists as East, Castle, Holmes, Popenoe, and Johnson have time and again declared that the Chinese are by no means mentally inferior to any other

people, yet many foreigners think that the Chinese are only fitted to be cooks or laundrymen!

Physically the Chinese are shorter and thinner than the Teutonic people on the average. But the Chinese are a mixed people of many sub-races, so their weight or stature may vary from the highest to the lowest, just as does the American. Travelling writers and moving picture producers, having for their sole purpose financial success, have often too grossly exaggerated the queer Chinese physique and personalities in order to please their reader or audience. Alas, the majority of the world has too often been ruled by illusions! There is little doubt that Chinese school children are not so well developed physically as the American, but this is due to the fact that physical education in the Chinese schools is poorer, and not to inherited deficiencies. If any one has seen the well developed physique of the Chinese farmers with their marvelous rigidity and durability, he will be convinced that the Chinese are not weak physically.

SOCIAL AND POLITICAL STANDARDS

We can be assured, then, that the Chinese people are not weak morally, mentally, or physically; but how about their social or political abilities? The social and political standards are determined by history and tradition rather than anything else. They are the results of the tastes and dreams of the people. So if a people changes its tastes and dreams, the social and political standards are changed accordingly. Judging the present Chinese society and government by western standards, they do not measure up very well, but one must know that the Chinese for forty centuries have had and will have forever their peculiar tastes and dreams. They must be judged by that standard. The Chinese are now undergoing a transitional period; they are trying to adapt themselves to the best arts of the western civilization according to their own ways and conditions. America took more than half a century to develop a strong central government, and "Rome was not built in a day." But despite all the difficulties the Chinese people have had to face, their social and political progress during the last decade has perhaps not been duplicated anywhere at any time. As mentioned above, history is the best measure to ascertain the hereditary ability of a people; is there any place since man has kept his record, where he has had a longer and more peaceful and prosperous life than in China?

The reader might now ask, since so much has been said about the good points of the Chinese heredity, "why don't you tell *why* it is so?" This question may be answered briefly by the following:

(1) The modern Chinese are derived from the mixing of many highly endowed tribes.

(2) In an over-populated country like China natural selection in the form of diseases and famines has been very severe.

(3) There are many Chinese religions or customs which are eugenic, such as ancestor worship, large family system, early marriage, etc.

(4) There is a predominant rural population—85 percent according to the best available statistics—and the farm is the best habitat for human beings.

The Chinese are, therefore, justified in being proud of their heredity. They have led civilization in the past, and they will contribute much in the future. What they need is self-confidence, and recognition of their good heredity by others. They should learn all that can be adapted from the western civilization, yet at the same time preserve and develop what is best in their own.

A. N. JONES—PLANT BREEDER

SOME REMARKABLE RESULTS IN HYBRIDIZATION AND ROOT SEPARATION

IDA JONES RICHMOND
Batavia, New York

MR. A. N. JONES of Batavia, N. Y., began his work in hybridization in 1869 at LeRoy, N. Y. By 1876 he had secured, by crossing seedlings, many promising hybrids of the potato and the strawberry. Among these were the Early Gem, Genesee County King, and Tioga potato, and the Laural Leaf strawberry, still found growing in his garden true to type. The Amber Cream sweet corn was originated in these early days, being catalogued first in 1879.

In 1878, Mr. Jones began his work in cross-fertilization of wheat, then considered a most difficult plant to cross. In this work he secured many hundred distinct hybrids of winter wheat. Careful selection was practiced and only those of marked excellence or distinct difference were introduced to the seed trade of the United States and Canada.

Mr. Jones, in an elaborate series of experiments in his plats, demonstrated the tendency of certain characters to perpetuate themselves. At that time comparatively little was known concerning the facts of inheritance. "Mendel's Law" formulated in 1865, by Gregor Mendel, an Austrian Monk who had experimented extensively with garden peas, was not known by the world at large. In his experimental work Mr. Jones evolved his own method of which he was justly proud. I am confident that dominance, segregation, and recombination were observed by Mr. Jones and were impressed upon his memory by hundreds of his own experiments. In all his cross-breeding he realized the importance of heredity; the "silent force which acts without expense" but so steadily, so surely. The pedigree of all his named varieties was worked out with infinite care and precision; note that of Early Genesee Giant as it appears in "the Basis for the Improvement of American Wheat" by Mark Alfred Carlton, Bulletin No. 24, Division of Vegetable Physiology and Pathology, U. S. Department of Agriculture. (Fig. 4).

In 1886, he introduced to the trade his first named wheat hybrid, Golden Cross, this being a cross of Mediterranean and Clawson. This was followed in 1888 by two other named varieties, New Early Red Clawson (a cross of Golden Cross and Clawson) and Jones' Square Head (a cross of Landreth and an unnamed hybrid) known in Canada as Harvest Queen by permission of Mr. Jones. These three varieties proved to be the vanguard of a series of wheats introduced over a period of years. In 1889 the first of Mr. Jones' hard gluten sorts, Jones' Winter Fife was sent out. Of this he had great hopes and said: "It is a boon to farmers and millers." This variety resulted from composite crossing of No. 87 and Mediterranean. In 1919 it was estimated by the U. S. Department of Agriculture that nearly half a million acres of this variety were grown in the United States, principally in Washington, Illinois, Missouri, Indiana, Idaho, and Montana in the order named. (Fig. 6.)

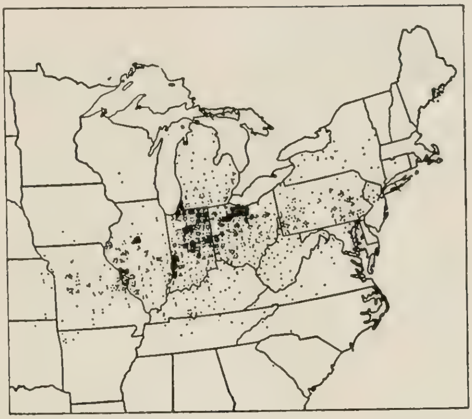
In 1889 he wrote as follows, "My most successful cross-breeding has been from combination (composite) crossing, as in crossing Mediterranean Longberry upon American wheat, progeny of which is crossed with Russian Velvet. A smooth chaffed wheat is sometimes used, progeny of which is again crossed with American wheat. This cross gives a strong healthy growth, deep root, thick walled stocky straw,

MR. JONES INSPECTING A PLAT OF HYBRID BEANS

In addition to developing over a score of wheat varieties of great economic value Mr. Jones did a great deal of work with beans, and introduced many important varieties. Some idea of the persistence and keen powers of observation required in this work may be gained by calling attention to the fact that Mr. Jones had as many as 1500 strains of hybrid wheat and beans growing in his experimental plats in one year. From this great number of hybrids grown each year, 50 or possibly 75 were selected as being of economic importance in the course of 35 years intensive work. (Fig. 3.)

THE GENEALOGY OF A FAMOUS WHEAT

Here the complexity of the plant breeder's work is somewhat visualized. From this series of crosses Jones' Genesee Giant was derived. No indication is here given of the great number of unsuccessful crosses made at the same time. Mr. Jones was able to hasten the development of desirable kinds by the process of root separation; from a single seed sown in August 1888, 27 pounds of wheat were harvested the following summer. (Fig. 4.)



THE DISTRIBUTION OF JONES' RED WAVE WHEAT

In 1919 more than a million acres of Red Wave wheat were grown in the United States. On a basis of ten bushels per acre, at $2.50 per bushel, the crop was worth twenty-five million dollars. Had the originator received a royalty of only one hundredth of one percent, he would have an income of $2,500 from this variety alone. On such a basis the originator of two or three varieties of commercial importance would be financially independent, and able to give his whole time, and an unworried mind to his work. (Fig. 5.)

and grain of a fine milling quality in a compact head."

In 1890, No. 8, or American Bronze, a variety adapted to poor or light land was catalogued. This hardy sort was a parent of some of the most desirable later varieties. Two superior varieties appeared in 1892, Early White Leader and Early Genesee Giant. The first mentioned was the result of a complicated composite cross, and was pronounced by millers "one of the whitest flour-making sorts grown."

In all his cross-fertilization of wheat Mr. Jones aimed to accomplish certain definite results, viz., to originate varieties best suited to a given soil; those best suited to certain climatic conditions; to secure increased size of spike and strength of straw; to secure those immune to attack of weevil and rust; and also to secure high gluten content.

In 1893, Mr. Jones removed to Newark, N. Y., in order to test the effect of change of soil upon his breeding stock. Pride of Genesee, having for one parent the old reliable Jones' Winter Fife, was introduced in 1893. It was named for the County in which it was originated, as was Early Genesee Giant.

In 1894, three new varieties were listed in the United States and Canada, (1) Bearded Winter Fife, a variety believed to possess increased gluten content, (2) White Seeded Golden Cross, recommended for dry or gravelly soil, and (3) Long Amber, recommended as "The Ice and Waterproof" wheat. These were all results of composite crossing of Mr. Jones' hybrids.

Early Arcadian introduced in 1895 was a beautiful wheat named for the town of Arcadia, N. Y., in which it was originated. It was a cross of Early Genesee Giant and Early Red Clawson and partook of all the good qualities of both parents.

In 1896, Oatka Chief, a wheat recommended for cobblestone land such as is found in the lake region, appeared. It was given the Indian name for its place of origin on the bank of the Oatka.

DISTRIBUTION OF JONES' WINTER FIFE WHEAT

Mr. Jones considered this the finest of his hard gluten varieties. More than half a million acres were planted to this wheat in 1919, the year for which this map was made. Although it is one of Mr. Jones' earlier introductions, dating from 1889, it is still an important and widely grown variety. (Fig. 6.)

Diamond Grit or Winter Saskatchewan was also introduced in this year. In Diamond Grit he believed that demand for high gluten content was met, for he wrote of it, "It is a worthy rival of the hard spring wheat of the Northwest."

In 1897, Early Red Rover and Jones Longberry No. 1, both most promising varieties, were listed. The latter was the result of several years' experiments in crossing this Longberry type. This sturdy sort made a record of 54½ bu. per acre, sown Sept. 22, on light cobblestone land, and in plat, of 63¼ bu.

Longberry Clawson of 1899 was also a result of composite crossing. It was adapted to strong clay loam, and upon such soil was inclined to club headedness. Mr. Jones had many hybrids having this form of head but owing to limited demand for such, few were sent to the trade. From examination of old breeding stock I find none with less than 60 grains to the spike in these varieties with club square head.

Jones' Early Red Chief of 1902 originated in the historic Seneca Indian region and this sturdy red progeny was named accordingly. Of it Mr. Jones wrote "It is strong at all points." Silver Sheaf Longberry (a cross of No. 8, Lancaster, and No. 91 Longberry), was first listed in 1902. This has a flinty grain almost as long as rye.

A plat of Paris Prize of 1904 was grown on the exposition grounds at St. Louis and attracted much attention. The spike of this wheat is immense, as is that of Mammoth Amber of the same year. Mr. Jones' exhibit of 500 hybrid wheats at the Pan American Exposition was awarded the Gold Medal and his exhibit at St. Louis won the Grand Prize. Mammoth Amber was one of the 43 crossbred wheats sent by Mr. Jones to Paris Exposition, 1900, in charge of the U. S. Department of Agriculture, and awarded the Gold Medal.

In 1906 Red Wave was introduced. It has an unusually long spike sometimes measuring 5½ to 6 inches. The U. S. Department of Agriculture estimates that over a million acres of this variety were grown in 1919. (Fig. 5.)

St. Louis Grand Prize of 1908 was a progeny of a new Russian wheat crossbred with a seedling. It was thought to be practically "fly proof" and was called a rough and ready sort.

The entire stock of Jones' Climax and a new Club head was sold in 1914. An observer said of the former variety "A field of the Jones' Climax is about as fascinating a sight as human eyes can look upon."

The above varieties comprise the list of authorized introductions of the Jones' wheats, with the exception of

an unnamed stock sold to a firm in Canada. It is possible others reached the seed trade in devious ways. Mr. Jones was of the opinion that No. 6, a variety widely grown in New York, was really one of his wheats.

Had Mr. Jones been less conservative, or had he been able to increase stock sufficiently fast, he could have introduced a score of varieties each year instead of from one to three as was his rule.

EXPERIMENTS IN ROOT SEPARATION

It was seldom he could practice root separation to a great extent in propagating his strains as it required more time and space than he could give it. His most notable experiment in 1888, created much interest. The soil of the experimental plat was prepared a year in advance and the surface was kept mellow. July 12th he planted one kernel of Jones' Winter Fife wheat. July 31st he separated the root, making four hills from the side shoots. August 17th he divided again making 15 roots from the four. Sept. 4th he obtained 75 roots and by Sept. 24th these were increased to 300. Oct. 10th there were 505, October 31st they had increased to 900. Nov. 22nd he divided again having 1140 roots. Thirty-six of these winter-killed leaving 1104. Some of these had from 18 to 24 large heads. From this plat 27½ pounds of wheat was threshed. Mr. Jones wrote of this as follows "The grain was very plump, bright and heavy and would have taken first premium at any agricultural exhibit."

From such small beginnings came the splendid hardy wheats that in a few years covered thousands of acres of our land.

BEAN BREEDING

At one time his trial plats contained more than 1500 hybrid wheats and beans. Among the latter were the following named varieties sent out to the trade: Jones' Ivory Pod Wax, 1881; Lemon Pod Wax, 1881; Jones' Round Pod Wax, 1898; Golden Crown White Seed Stringless Wax, 1899; Garden Pride Stringless Green Pod, 1902; Green Pod Stringless, 1902; Jones' Marrow Pea, 1909. The Jones' Ivory Pod Wax was a parent of many of the later sorts.

As Mr. Jones never delegated to others any important work connected with his experimental plats it is readily seen how much work he accomplished. Possibly his heritage from sturdy English ancestors enabled him to endure this painstaking labor for thirty-five years.

BIOGRAPHICAL

Mr. Jones was born in 1843, at Cookham, situated upon the Thames River, England. At the age of five years he came with his family to America, and located in Rochester, N. Y. The three Paper Mills at the Lower Falls were later owned by the Jones Bros. when much of Main Street was a common. None of the processes of the trade of his youth were of use to him in his chosen work, with the exception of finishing, which at that time was done by hand, and required a certain dexterity in counting, best learned in early youth.

The secret of his ability to produce such a great number of desirable hybrids is found in his unbounded enthusiasm, unlimited patience, painstaking care, and absorbing love for his work.

A New Approach to Eugenics

Is America Safe for Democracy? by William McDougall, professor of psychology in Harvard University. Pp. 218, price $1.75. New York, Charles Scribner's Sons, 1921.

In a most readable and fascinating book, Dr. McDougall brings some of the data of anthropology or racial psychology to bear on the problem of eugenics. He starts with the question whether there are innate, germinal differences between the people of different races. Suppose for a given period all the English and French babies born could be exchanged in their cradles; would the subsequent history of the respective countries, and their literature and institutions, undergo a marked change? To arrive at an answer, he starts by an analysis of the art of different nations. This he supplements by examining some other fundamental traits, and draws a picture of the Nordics, characterized by a relatively high degree of curiosity, self-assertiveness, alcoholism, tendency to suicide, protestantism in religion, and a high divorce rate, as contrasted with the Mediterraneans, who are more gregarious, free in expression of their emotions, submissive, and Roman Catholic in their religion. These qualities are largely reduced by the author to a single fundamental constitutional difference: the Nordics are prevailingly introvert, the Mediterraneans extrovert. The Alpine race, he thinks, occupies a position somewhat intermediate. The consequences of these constitutional differences are so far-reaching and unmodifiable, the author believes, that the imaginary replacement of English by French babies, above alluded to, could not fail gradually to result in transposing the institutions and customs of the two nations. The moral qualities are, in their origin, likewise innate, Dr. McDougall believes, and he rightly lays great stress on their importance in racial history. He believes that the valuable and irreplaceable Nordic qualities are already well on their way to extinction in England, and that a similar result is imminent in the United States, due to the race suicide of the possessors of the traits. His principal suggestion, in the way of remeay, is for the institution of a wage-scale in all public offices, whereby salaries would be increased in proportion to the size of family of the office-holder. He also advocates the public registration of family histories. —P.P.

Books Received

The Population Problem, by A. M. Carr-Sannelers, The Oxford University Press, New York, 1922.

Foundations of Biology, by L. L. Woodruff, The Macmillan Co., New York, 1922.

Why Die so Young?, by John B. Huber, Harpers, New York, 1922.

Hormones and Heredity, by J. T. Cunningham, The Macmillan Company, New York, 1922.

The Minds and Manners of Wild Animals, by William T. Hornaday, Charles Scribner's Sons, New York, 1922.

EDUCATIONAL ANTHROPOLOGY

By Arthur MacDonald
Washington, D. C.

IN GENERAL, the introduction of new words or terms into a language should be discouraged, but when they indicate a new direction or application of thought, they may prove serviceable, especially if they tend to more *scientific* methods. Educational anthropology is a study of mental and physical life, as applicable to educational forces, just as educational psychology is an investigation of mental life in connection with similar forces. That is to say, while educational psychology deals mainly with the mental, educational anthropology is concerned with both the physical and mental, with emphasis on the moral, especially in connection with criminal anthropology, popularly called "criminology." That is, moral education is most important; otherwise, what is the use of educating the young and having them graduate into prison, as so many do? Educational anthropology refers to modern civilized man, rather than to savage and prehistoric man, and is of very recent date. A proof of this is the fact, that the first scientific study ever made of a human being was that conducted upon Emile Zola by some twenty French specialists in anthropology, psychology, and medicine. This was published in 1897.[1]

RELATIONS OF EDUCATIONAL ANTHROPOLOGY

Education may be defined, in a simple way, as the process by which a community and person are brought from where they are to where they ought to be. Where they are and where they ought to be at every period of their physical and mental development, are questions of educational anthropology. We may also define education as the process by which the ideas, institutions, and habits of civilization are handed down to the new born and to the young. That is, education is the process of *social heredity*, as distinguished from germ heredity which relates to inborn native tendencies, coming from our ancestors.

Education may consist of all the processes by which a community transmits its acquired power and purposes, in order to continue its own existence and growth. Society is made up of the young and inexperienced and of the old and experienced. Since the old will soon die, the new born and younger members must be so reared and educated, that they will appropriate the functions and values of the old. The physical and mental processes of growth, if not directed, cannot maintain the habits and ideals in vogue. That is, the institutions and customs of civilization cannot be maintained except by social heredity, by deliberate educational processes applied to the young. Otherwise civilization would cease.

The higher the civilization the greater the difference in level between the new born and the aged, and this widening gap increases the necessity for education as the main condition for the preservation of civilization.

Educational anthropology must find the biological equipment for affecting growth and development in both the child and the community. Hence the increased attention given to eugenics, to child study, to the problems of normal, accelerated, and retarded growth. Here anatomy of the brain and school hygiene assume much

[1] The author has made a summary of this study in his work entitled "Juvenile Crime and Reformation," Senate Document No. 632, 60th Congress, 1st Session.

importance, due to the social interest in anatomical and physiological characteristics of man, especially in connection with educational institutions.

Educational anthropology depends much upon medical data, especially as related to physical education and school hygiene, as the study of growth in children. It emphasizes the importance of knowledge of the child, as a basis for all teaching, in addition to a knowledge of the subject matter of instruction.

The growth of children has assumed much importance in education. Here educational anthropology considers not only the establishment of age standards, but the correlations of growth, ability, and physical and mental development. The measurements of children of the same age show different physical developments, which increase as the age increases. Thus the processes involved in learning to read, spell, and write, require an educational anthropologic analysis, and the physical and mental tests at present so dominant are included in this analysis.

Educational anthropology on its ethnological side is closely affiliated with the history of civilization. It helps to develop the idea of the evolution of modern society from primitive forms, suggesting that the development of a child should follow, to some extent, the manifestations of life of primitive peoples.

Educational anthropology, like educational psychology, includes the selection and organization of anthropologic data of practical service to teachers. Education has two general purposes; one is to train and develop the native tendencies, and the other is to transfer or hand down to the young the results of civilization. This transfer is the process of learning. The study of this process by which the physical, mental, and moral acquirements of civilization are given to the young, is an educational anthropologic problem. This process of transference depends upon methods of learning and the capabilities of the pupil. In connection with this process, educational anthropology treats of the activity and development of body and mind with certain prescribed ends in view. These ends or results, serve as tests by which the success of the educative process is to be measured. Thus much of the material for educational anthropology consists in methods of learning as illustrated and applied to school work.

EDUCATIONAL ANTHROPOLOGY AND RURAL EDUCATION

Educational anthropologic study, which includes mental and physical tests as applied to rural schools, concerns also educational psychology in all its phases. In general, the scientific study of children, adolescents, and adults, both mentally and physically, in relation to all kinds of education, comes under the head of educational anthropology. Its scope is obviously very large, and it would take too much time and space at present to deal with its relations to the many branches of education. It may, however, be useful very briefly to consider the relation of educational anthropology to some of the more recent phases of education, as rural and industrial education, and also physical education and school hygiene.

Many years ago, the author had some experience as a teacher in rural schools. As he now looks back, it becomes painfully evident how much such schools were neglected; and at present they need the advantages coming from the scientific study of school children, which educational anthropology in its various branches can present. All anthropologic studies of school children, including physical and mental tests of them apply, of course, to rural education.

One of the difficulties the author found in rural schools was the physical uneasiness and restlessness of the large boys in winter time. They could not sit still long, nor keep their attention under control, so that they did not study very much, although they were not lazy; for they were all hard workers on the farm. One of them said,

"How much more difficult it is to sit still and study than to do the hardest kind of farm work." It is physiologically unnatural to make children, or larger individuals, sit still a relatively long time, for children are normally very active, and these boys were accustomed to hard physical labor. In general, all education is physically unnatural to a certain extent. If we left the children alone, they, of course, would become little barbarians, though doubtless stronger and healthier physically. But they would not be adapted to modern life. So the problem is to employ such educational methods as will make individuals best prepared for the duties of life, without taking too much from their physical well being; that is, the purpose of educational anthropology in rural education is to find the golden mean between the physical and mental life which will be best adapted to rural life.

SCHOOL HYGIENE AND PHYSICAL EDUCATION

There is already much literature on school hygiene in medical, psychological, and anthropological periodicals. It is based principally upon medical and anthropological studies, such as anatomy and physiology, in connection with influences that act injuriously upon organs and their activities. Intelligent knowledge of hygiene is almost impossible without familiarity with anatomy, physiology, and pathology, the bases of the subject, which are best obtained by a medical education.

Hygiene of the school child deals with the character of the child's body and also the laws of growth, and seeks to determine methods of avoiding the dangers inherent in each stage of physiological and psychological development. Hence, important contributions to school hygiene have been made by the many scientific studies of growth and development, of the diseases and abnormalities of school children. The relation of the physical development of children to intelligence, the incidence of diseases by years, grades, and seasons, and the relation of defects to school progress are some of the most important questions in school hygiene. Also medical inspection of schools is a basic study under the head of school hygiene and physical education.

The psychology of instruction also shows the importance of mental habits formed by education. The study of fatigue, for instance, with anthropological instruments of precision is of practical importance in determining the length of periods of work and rest, study and recreation. The development of healthy habits, mental activity, self-control, and concentration are practical features of anthropological studies showing the hygienic importance of mental training and activity.

COURSES FOR STUDENTS IN EDUCATIONAL ANTHROPOLOGY

Since the scientific study of modern man requires the aid of many specialists, it is evident that no one person can go into all the phases of the subject in detail, but may consider only their general relations. In view of this fact, what preparation is requisite to undertake investigations in educational anthropology?

When a student chooses for his life work a subject in the older branches of knowledge, as physics, philosophy, philology, Greek, Latin, or natural history, he finds the field well developed; but this is not so in the more modern branches of research, such as educational anthropology, and other cognate subjects. In these fields there is abundant opportunity for mental acumen and scientific ability of the highest character to help carry out moral educational ideals.

The question may arise as to what courses of study will best prepare one for such work. The following post graduate plan of studies is suggested:

1. Courses in general anthropology, ethnology, and history of civilization.
2. Courses in general biology, evolution, genetics, and eugenics.
3. Courses in psychological laboratory work.

4. Medical studies in anatomy, craniology, physiology, general pathology, nervous diseases and insanity, especially clinical studies.

5. Modern languages.

Thus educational anthropology requires more extensive preliminary training, perhaps, than any other subject, for it involves the investigation of man both mentally, morally, and physically. Such training is comprehensive, which in this age of specialization is much needed. At least a few students should be trained to combine and utilize cognate branches of knowledge. They should know enough of such branches properly to interpret the results obtained by specialists. Since such education is relatively new and experience in it is, as yet, limited, it is difficult to designate preparatory courses more definitely than has been done above, as only general suggestions are feasible at present.

PUBLICATION OF SECOND EUGENICS CONGRESS PROCEEDINGS

THE following communication has been received from Dr. Charles B. Davenport in regard to the publication of the Proceedings of the second International Congress of Eugenics:

Those interested in the Second International Congress of Eugenics held in New York City last autumn will be pleased to learn that arrangements have been made with Messrs. Williams and Wilkins of Baltimore by which they are to publish the Proceedings. These are to be printed in two volumes: I, "Eugenics, Genetics and the Family" and II, "Eugenics in Race and State." Besides the numerous papers there will be published in the books a series of about 60 full page photographs, reproducing a considerable part of the exhibit. Prior to publication the publishers offer the two volumes at $9; after publication $11. It is suggested that persons who desire to secure these volumes should write at once to the publishers, to be entered for the set at pre-publication price.

Besides the more general addresses of Osborn, Leonard Darwin, Davenport, Cuenot, Lucien March and De la Pouge there are special papers by the geneticists Jennings, McClung, Bridges, Blakeslee, John Belling, G. H. Shull. P. W. Whiting, H. J. Muller, C. Zeleny, A. F. Shull, A. M. Banta, H. J. Bragg, E. C. MacDowell, Sewall Wright, C. C, Little, C. C. Hurst, Helen D. King. More strictly eugenical papers are by physicians, statisticians and professional eugenicists such as Dr. Woods, Mrs. Ruth Martin, H. J. Banker, A. H. Estabrook, W. E. Key, Elizabeth Greene, R. H. Johnson. An analysis of the Oneida Community Experiment is given by two of the descendants of its founder. Inheritance of musical traits is considered by Drs. J. A. Mjöen, C. E. Seashore and Hazel Stanton. Race mixture is considered by Hooton, L. C. Dunn, Maurice Fishberg, W. F. Wilcox, F. L. Hoffman. The problem of population is analyzed by Raymond Pearl, E. M. East and Sir Bernard Malet. There are a number of important papers on anthropometry and development. The field of preventive eugenics is represented by C. W. Saleeby, R. A. Fisher, H. H. Laughlin and W. S. Sadler. Interesting papers on inheritance in relation to education, immigration and race betterment are included. The volumes include a number of portraits of eugenicists.

ZYGODACTYLY AND ITS INHERITANCE

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NORMAL WEBBED TOES

In certain early developmental stages the human foot is normally webbed. Very soon afterwards the webs disappear and the toes become separated. If this reduction of the webs fails to take place the condition of web-footedness results. Note that this normal pre-natal webbing is greater between the second and third toes than between the others. (Fig. 7.)

A SIMANG'S FOOT

Webbing occurs repeatedly between the second and third toes of these apes found in Borneo and Sumatra, and it is also found in other animals. It represents an arrest in normal development, in contrast to conditions like split-foot, characterized by union of the boney elements of the hand or foot, which are brought about by deep developmental disturbances. (Fig. 8.)

THE last two volumes of the JOURNAL OF HEREDITY each contains a report on the inheritance of web-formations between the second and third toes in man[1,2] and the writer has come across several other articles, scattered through the literature, in which this anomaly has been traced through a number of generations. It seemed desirable to collect these various studies, each of which was made independent of other recorded cases, in order to be able to draw wider conclusions from the larger material, to correct some slight misstatements made by previous authors, and to stimulate further collecting of such cases.

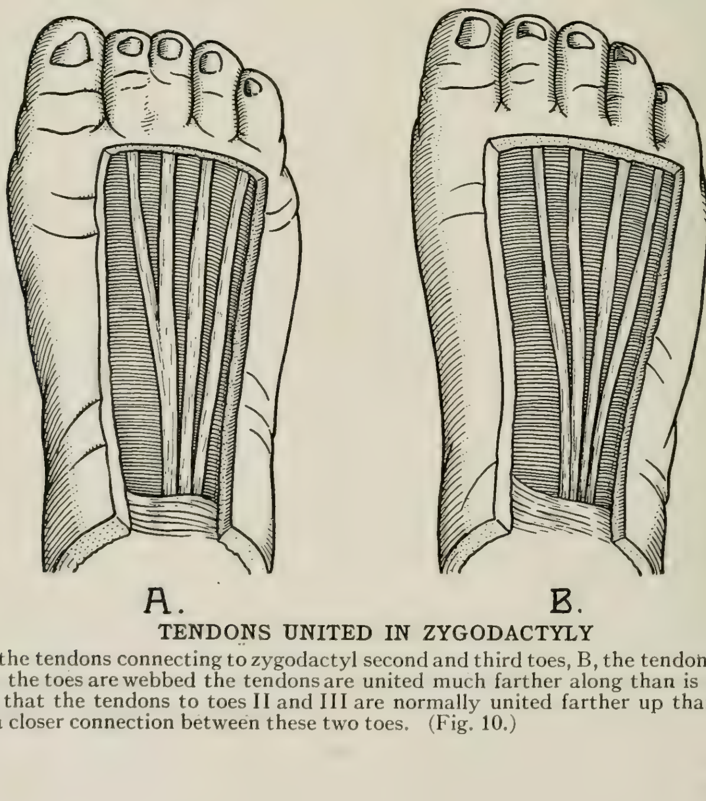
Before taking up the question of heredity, it might be well to consider in more detail the anomalous condition itself. In figure 7 is shown a very early developmental state of the human foot. From this it can be seen that during growth the toes pass through a phase in which they are normally joined by webs. Between the second and third toes this web-formation extends slightly farther than between any of the others. Very soon afterwards the toes become separated, i.e., the webs are reduced to

[1] Hurlin, R. G. 1920. A case of inherited syndactyly in man. J. of Heredity, vol. XI, pp. 334–335.

[2] Schofield, R. 1921. Inheritance of webbed toes. J. of Heredity, vol. XII, pp. 400–401.

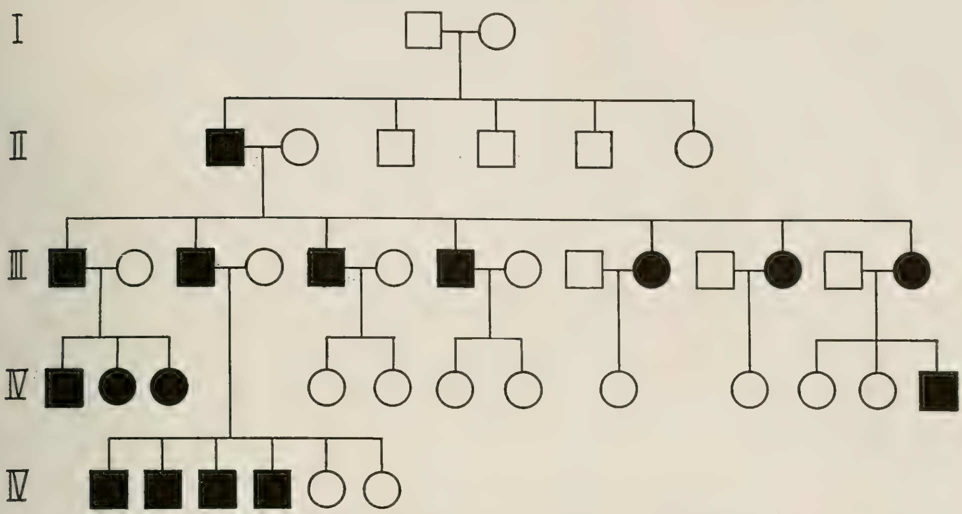
ZYGODACTYL TOES

Zygodactyly, or union of the flesh between the toes occurs more often between the second and third toes than between any others. They seem to have a natural affinity for each other as indicated in Figs. 7 and 10. It is not a common condition; one investigator found only eight cases in examining 20,000 men. (Fig. 9.)



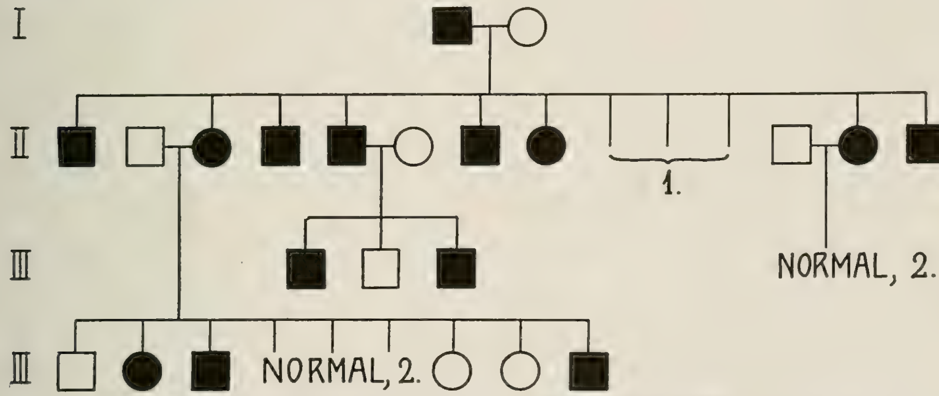
TENDONS UNITED IN ZYGODACTYLY

A shows the tendons connecting to zygodactyl second and third toes, B, the tendons in a normal foot. When the toes are webbed the tendons are united much farther along than is normally the case. Note that the tendons to toes II and III are normally united farther up than the others, pointing to a closer connection between these two toes. (Fig. 10.)



THREE GENERATIONS OF ZYGODACTYL TOES

The inheritance of zygodactyly between the second and third toes on both sides for three generations. In this family the character is more likely to be inherited by men than by women. Redrawn from Pfitzner.[6] (Fig. 11.)



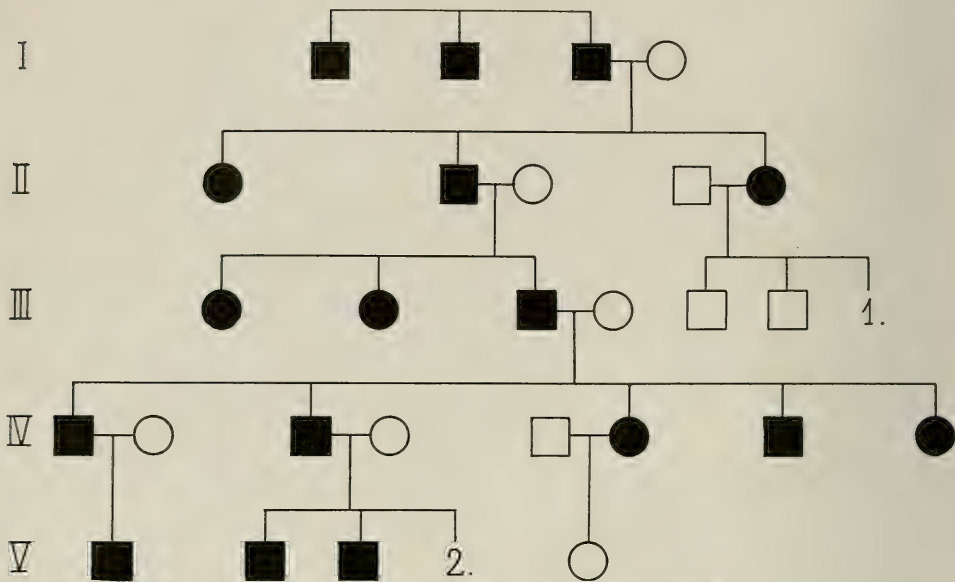
THE INHERITANCE OF ZYGODACTYLY BETWEEN THREE TOES

The first, second, and third toes on both feet are united by webs. Webbing between the fingers is frequently associated with webbed toes, and is a character that should be looked for in future investigations of zygodactyly. Redrawn from Wolff.[5] (Fig. 12.)

small remnants at the base of the toes. If this reduction does not take place, as in the few individuals with webbed toes recorded in the literature, it must be classed as a local developmental arrest.

The term "syndactyly" or "syndactylism" is commonly applied to this condition of webbed toes or fingers; however, the same name is given as well to the union of the bony elements of foot or hand and sometimes to the partial or complete lack of toes or fingers ("split-foot," etc.). These last mentioned anomalies are not an arrest in otherwise normal development, but are due to various deep developmental disturbances and are therefore genetically different from the condition described in this paper. Weidenreich,[3] in a recent paper, proposes to call the condition of webbed toes or fingers *zygodactyly* to distinguish it from all

[3] Weidenreich, F. 1921. Der Menschenfuss. Zeitschr. f. Morphol. u. Anthrop., vol. XXII, pp. 51–282.



ONLY THE RIGHT TOES WEBBED IN THIS FAMILY

Only the second and third toes on the right foot are united. (1) number of sons unknown, all normal; (2) number of sons unknown, all with webbed toes. In this case the character is sometimes inherited by the women, but it is only transmitted by the men. Redrawn from Sommer.[7] (Fig. 13.)

other forms of syndactyly, a suggestion which should be welcomed, in view of the differences in origin in the various types of syndactyly.

Zygodactyly is not restricted to man; it is found in many mammals, such as several groups of marsupials and in the Simangs, apes from Sumatra and the Malay Peninsula. In these animals skin-fusion between the second and third toes is a constant occurrence. Figure 8 shows this in a Simang in a late stage of prenatal development, proving again that zygodactyly is a congenital condition. In the large majority of the reported cases of zygodactyly of the human foot the fusion, as in the mammals just mentioned, exists between the second and third toes only. For instance, in the 8 individuals with zygodactyly, found by Schurmeier[4] among a total of 20,000 men examined, the anomaly occurred always between toes II and III. It seems highly probable, therefore, that these two toes possess a special tendency or predisposition to fuse. As shown above, in early development the normal webbing is more pronounced or persists slightly longer between these two toes than between the others. It is also known that the tendon for the long extensor muscle of the toes is split farther up between the third and fourth and fifth toes than between the second and third, another fact pointing towards a greater unity between the last mentioned toes. Weidenreich found in two adults with zygodactyly of these two toes that the tendons of the extensor digitorum longus muscle for toes II and III were in common, or unsplit, for an unusually long distance, i.e., to the middle of the dorsum of the foot. This finding was confirmed by the author in the case of a zygodactyl newborn (fig. 10).

A number of cases have been described in which zygodactyly between the second and third toes was associated with zygodactyly of varying degree between the third and fourth

[4] Schurmeier, H. L. 1922. Congenital deformities in drafted men. AM. J. OF PHYS. ANTHROPOL., vol. V, pp. 51–60.

fingers (Roskoschny,[5] Wolff,[6] or between the first and second, fourth and fifth, or even between all the fingers (Pfitzner).[7] Such correlations between web-formations of foot and hand are of special interest and should always be carefully searched for in future records of zygodactyl toes.

Webbing between the second and third toes may occur only on one side in all the affected members of a family, as the family reported by Sommer,[8] in which it appeared on the right foot only; or the web may extend farther on the right than on the left side, as in the family recorded by Schofield, or vice versa, as in the case of Hurlin. Finally, zygodactyly of the foot is not restricted to the male sex and therefore is not a secondary sex character, as assumed by Schofield; it has been observed in a number of females as well. The writer, for instance, found it in a newborn girl, the zygodactyl feet of which are shown in figure 9.

The three charts given in this paper were redrawn by the author from reports found in the literature, showing the inheritance of zygodactyly. The original pedigrees were presented according to widely different methods, but in their present shape they will be found easier for comparison with one another and with the two charts recently published in this journal.[1,2] The following general conclusions in regard to the rules of heredity of webbed toes can be drawn from the pedigrees given herein, together with those by Hurlin and Schofield. It can be stated, first of all, that apparently in no zygodactyl family does the anomaly skip a generation; i.e., those individuals who are free of the condition, although of zygodactyl strain, will in all probability have only normal children. Another striking feature is the fact that the chance for the female to transmit webbed toes to her children is very much less than for the male. However, since this does occur, the conclusion by Castle[9] based upon the pedigree by Schofield, that webbed toes have the distribution in heredity of a Y-chromosome, is not borne out by our material. It also seems that female progeny is in general less apt to inherit zygodactyly than male offspring. How closely the condition is inherited is shown by the number of families in which an affected father transmits the defect to all of his children (Fig. 13: in all generations except where transmitted by females; Fig. 11: generation III and one generation, IV; Schofield: one generation, IV). Only when more pedigrees for zygodactyly have been recorded will it become possible to enlarge on these conclusions and at the same time to place them on a firmer basis.

[5] Roskoschny, F. 1918. Symmetrische Syndactylie beider Hände und Füsse. D. Mediz. Wochenschr., vol. XLIV, p. 350.

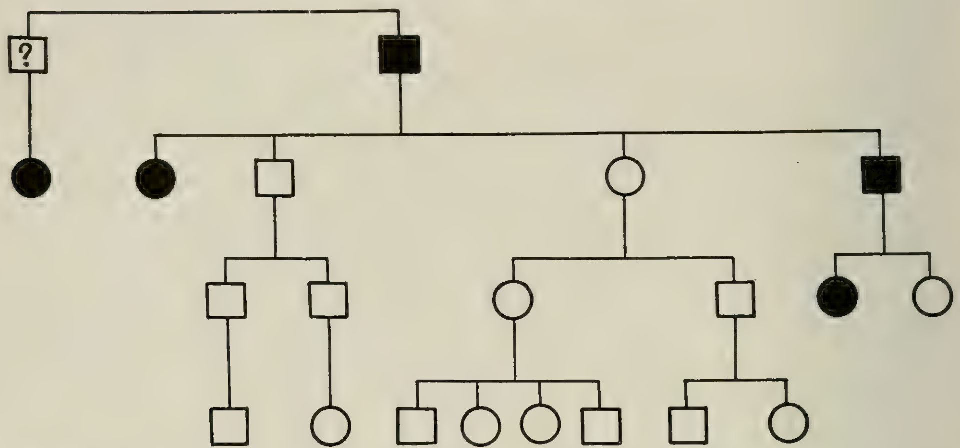
[6] Wolff, F. 1918. Ein Fall dominanter Vererbung von Syndactylie. Archiv f. Rassen- u. Gesellsch. biol., vol. XIII, pp. 74–75.

[7] Pfitzner, W. 1898. Beiträge zur Kenntnis der Missbildungen des menschlichen Extremitätenskelets. Morphol. Arbeiten, vol. VIII, pp. 304–340.

[8] Sommer, 1916. Zur forensischen Beurteilung der Erblichkeit von morphologischen Abnormitäten under der Papillarlinien der Finger. Arch. f. Kriminologie, vol. LXVII, pp. 161–174.

[9] Castle, W. E. 1922. The Y-chromosome type of sex-linked inheritance in man. Science, vol. LV, pp. 703-704.

Another Pedigree of Webbed Toes



A PEDIGREE was recently published by Schofield[1] in the JOURNAL OF HEREDITY in which a very unusual mode of inheritance was indicated. The character involved was a web between the second and third toes. This was transmitted by five web-toed men of three generations to every one of their sons (13 cases) but to none of their daughters (11 cases). Daughters of these webbed toed fathers had 2 normal sons and 5 normal daughters. The only parallel case seems to be that found recently by Schmidt[2] in the fish Lebestes reticulatus. Schmidt has pointed out that an exclusively male character which is transmitted by father to every son follows exactly the mode of transmission of the Y chromosome. Recent work by Painter[3] indicates that there is an X-Y sex-determining pair of chromosomes in man.

Another pedigree, involving what seems to be the same trait, webbing of the second and third toes, has been sent to the JOURNAL OF HEREDITY by Dr. Ira S. Wile, who calls attention to its failure to follow the rules found in Schofield's pedigree. In three cases there is transmission from father to daughter and in one case there is failure of transmission from father to son. The pedigree indicates that webbing in this case depends on a single dominant unit with no relation to sex, a conclusion which agrees with that drawn by Hurlin[4] from another web-toed pedigree, published earlier in the JOURNAL OF HEREDITY.

These apparent inconsistencies indicate that webbing may be determined by different unit factors in different families. Such a result is not especially surprising. It is known for example that night blindness follows the sex linked mode of inheritance in some families, while acting as a simple dominant in others.

S. W.

[1] Schofield, Richard, "Inheritance of Webbed Toes," JOUR. HEREDITY, (1922), 12, pp. 400–401.

[2] Reviewed by W. E. Castle, "A New Type of Inheritance," Sci., N. S., (1921), 53 pp. 339–342.

[3] Painter, T. S., "The Y-Chromosone in Mammals," Sci., N. S., (1921), 53, pp. 503–504.

[4] Hurlin, R. G., "A Case of Inherited Syndactyly in Man," JOUR. HEREDITY, (1920), 11, pp. 334–335.

AN AUSTRALIAN CITRUS RELATIVE

NOTES ON THE RUSSEL RIVER LIME

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IN THE Journal of the Washington Academy of Sciences (V. pp. 569–578) Dr. Walter T. Swingle has separated the Australian plants which had previously been placed under Citrus into a distinct genus which he terms Microcitrus.

One of the most interesting of these species is *M. inodora*, the so-called Russell River Lime of which Dr. Swingle (l.c. p. 578) states—

> "So far all attempts to introduce the Russell River Lime into culture have failed and the rapid clearing up of land along the Russell River threatens to exterminate the species altogether. It is hoped that Australian botanists and fruit-growers will not permit this to happen."

The United States Department of Agriculture has long been trying to get seeds of this plan for the citrus breeding experiments being conducted under Dr. Swingle, and has written many times to the Australian Department of Agriculture and Stock in Brisbane to obtain seeds of this citrus fruit as well as of *Garcinia Mestoni* or Meston's Mangosteen which grows in the same locality and in which Dr. David Fairchild has taken great interest. In January of this year I received instructions to try to collect seeds of both these plants while on a visit to North Queensland in connection with other botanical matters.

The Russell River and Bellenden Ker Ranges, the area where these plants occur, is situated in the North-east of Queensland. It is also the wettest part of Australia, the rainfall averaging over 170 inches per annum. The rainy season lasts from January to April, and during the whole of my stay in the district in early March, it rained continually and the registered rainfall for the previous month (February) was 62 inches. It is a fairly thickly settled country, most of the lower parts being given over to sugar growing.

Meston's Mangosteen (*Garcinia Mestoni*) occurs on the Bellenden Ker Ranges growing from altitudes of about 2,000 feet to 4,700 feet, of "within 300 feet of the summit of the South Peak."[1] At these altitudes the tree is one of the commonest on the Bellenden Ker Ranges, if not *the* most abundant tree. It only grows to a height of 20 to 30 feet and is of very graceful appearance. It is heavily foliaged with small, long pointed, bright, glossy, deep green leaves. Unfortunately, no trees bearing ripe fruit were seen, and it is possible that the phenomenally wet weather experienced during the past season militated against fruit being set. However, as trees are abundant within 3 miles of Bellenden Ker Railway Station, on the Cairns—Daradgee Railway, no difficulty should be experienced in getting ripe seed, as soon as it is available.

Better success was met with in the case of the Russell River Lime. It was found to be common in the lowland rain forests at the foot of the mountain, and many of the trees were bearing ripe fruits.[2]

[1] Mestoni—Report by Mr. A. Meston on Expedition to the Bellenden Ker Range—Brisbane 1904 (Parliamentary Paper).

[2] Seeds (about 200) were received in June 1922 from Dr. White in good condition, as well as good herbarium specimens with fruits attached. The seeds are now being grown in the Citrus Quarantine Greenhouse of the U. S. Dept. of Agriculture at Bethesda, Md.

The other three known species of Microcitrus, *M. Australis* (round lime) *M. Australasica* (finger lime) and *M. Garrowayi* (Garroway's lime), all from Australia, are already growing in the collection of the U. S. Dept. of Agriculture. *W. T. Swingle*

LEAVES AND FRUIT OF RUSSEL RIVER LIME

This wild relative of the cultivated citrus is found only in a very restricted area of northeast Queensland. Dr. White sent in the first seeds of this variety ever received by the U. S. Department of Agriculture. There are only three known species of the genus Microcitrus, all of which are found in Australia. A, twig from a tree growing on the edge of a clearing; B, one from a tree growing in the shade of the forest; C, under surface the leaf from same tree; D, fruit; E, seeds. Photograph one-half natural size. (Fig. 15.)

It comes up freely as a second growth after the forest has been cleared, and many trees are found along the edges of clearings, in such situations they seem to fruit very heavily, although the trees themselves do not seem to be as healthy as those growing in the shade of the heavy rain forest.

The description of *Microcitrus inodora* given by Bailey (in Botany, Bellenden Ker Exped. p. 34, 1889 and Queensland Flora 1. p. 215, Plate 10, 1899—under *Citrus*) might be amplified by a few details.

Microcitrus inodora forms a shrub or small tree of rather straggling habit, about 8–12 feet high with a trunk diameter of 1½–2 inches (4–5 cm). The leaves vary considerably in size and trees growing in the open or on the edges of clearings are always similar to those described by Bailey (l.c.) but when growing in the shade of the heavy tropical forest they vary considerably, attaining a greater size, particularly in breadth; leaves up to 7 in. (18 cm) in length and up to 4 in (10 cm) in width being met with. The trees were not in flower at the time of my visit but bore numerous fruits. The fruit is bright lemon yellow when ripe, oblong or obovate in shape, and may be either quite smooth or somewhat ribbed, with ribs corresponding to the cells or loculi, although this latter character, stressed by Bailey and again by Swingle, (l.c. p. 577) is a rather unusual, almost an abnormal feature. The larger fruit attain to a length of 2½ in. (6.5 cm) and are 1¼ in. (3 cm) in diameter, but the average is rather smaller. They are 8 celled and possess the characteristic rather loose stalked pulp-vesicles of other species of Microcitrus.

It is interesting to note in passing that all the Australian species of Microcitrus occur in Queensland. The Queensland flora has very close affinities with that of Papua, particularly with the Southern coast of Papua, from which two endemic species of Citrus have been described, viz *Citrus papuana* Bail. and *C. Warburgiana* Bail.[3] The flowers of both these species are unknown and it would be interesting to note into which genus—Citrus or Microcritus—at least one of them should be placed. *C. papuana* possesses a large orange-like fruit and a leaf with a winged petiole; it is no doubt a true Citrus. *C. Warburgiana*, on the other hand, bears a small fruit and short stalked leaves: it may when better known, have to be classed under Microcitrus.

The Psychopathic Child

Juvenile Delinquency, by Herbert Henry Goddard, director, Ohio Bureau of Juvenile Research. Pp. 120. New York, Dodd, Mead & Co., 1921.

American courts are picking up many thousands of delinquent boys and girls every year. "A very small percentage of them are ever restored so as to contribute their share to the general welfare. The most of them are always a burden and many of them become our most dangerous criminals." To remedy this state of affairs, the first thing necessary is a careful study of these juvenile delinquents, and Dr. Goddard's little book is in large part devoted to a description of the work of the Bureau which he heads. He undertakes to offer no ready-made program of remedies, but he does stress the importance of congenital syphilis in the causation of what he considers one of the most serious problems—that of the psychopathic child. The feebleminded child is mentally defective, or undeveloped; but the psychopathic child is mentally diseased—it is a case of incipient insanity. The author sees great hope for progress in the study of this type, and the study of its relation to syphilis in the parents.—P.P.

[3] Annual Report on British New Guinea, 1900–01, p. 142, with a Plate.

FIGS WITH MISPLACED SCALES

The fig has a very peculiar structure, not closely paralleled in other families of plants, the fruit being in the nature of a hollow branch with the flowers on the inside. A minute aperture at the end of the cavity allows the fig-insects to bring in pollen and fertilize the flowers. Normal figs have small scales, or "bracts," at the mouth of the aperture and at the base of the stalk, but scales are not scattered on the surface of the fruit as in the more or less abnormal specimens shown in these natural-size photographs.

Such abnormalities occurred on many trees in a seedling orchard at Bard, California, in the spring of 1917. Some fruits had only one or two scales misplaced, others several scales, while the more striking cases had scales in a regular spiral sequence or forming a distinct rim, as though two fruits were partially formed, one inside the other. (Fig. 16.)

FIGS WITH MISPLACED SCALES

The structure of the normal fig fruit as a shortened, fleshy branch is more easily understood from a study of these abnormal figs. Since each of the scales may be supposed to represent the leaf of a specialized joint, or internode, of the fruit-branch, the scales serve to indicate the number and arrangement of the internodes of which the fruit is composed. Interpreted in this way, the fleshy wall of the fruit evidently represents a series of internode elements standing side by side and completely fused, though the scales remain distinct.

In normal fruits the component internode elements are of equal length, though unequal in these abnormal fruits, which accounts for the scales being misplaced. Some relatives of the fig have hollow inflorescences uniformly covered with scales, showing that the internode elements are not specialized into two distinct kinds as in the fig fruits. The loss or reduction of specialization in internodes or other organs is characteristic of a large class of abnormalities which have been called metaphanic variations. (Fig. 17.)

THE INHERITANCE OF ABILITY

A study of the rôle of heredity in Terman's case histories of forty-one superior children

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IN A RECENT book, Professor Lewis M. Terman of Stanford University has presented case studies of 41 children who were found by mental tests to be exceptionally intelligent.[1] It seemed worth while to extract the data he gives regarding their ancestry, in order to bring this feature of the story into relief.

Concerning the parents or the hereditary strain of six of these children, there are no data given. What we know about the parents of the remaining thirty-five children, as is shown by education, occupation, and family connection, would seem to indicate that the parents of superior children are, in almost all cases, themselves superior. In many cases full information about the parents and relatives is not obtainable but a study of what we have reveals the following interesting facts:

In twenty-two cases the occupation of the father is given. Of the twenty-two, eighteen are professional men.

In seventeen cases one of the parents is a college graduate. In several other instances the parents are spoken of as "well-educated," "of superior ability," etc., but no indication is given of how far they went in school.

Seven of the children have both father and mother who are college graduates.

The parents of four have only common school education. In three of these cases some relatives are mentioned as being superior.

Only in two cases is it said that there are no superior relatives on either the father's or the mother's side. In both these families there are other remarkably bright children beside those tested so it would appear that there must be some superiority in the stock from which they came.

Eleven of the children have unusually fortunate heredity. In many cases the superiority has been noted for several generations and is widely distributed among various branches of the family. The superiority is usually general in both child and parents but where it is focussed upon a special subject, the particular interest of the child is almost as likely to be different from that of his parents or relatives as it is to be like it. At least one parent of ten, of the eleven children, who ranked at 150 or higher was a college graduate.

A brief record of the heredity of each of the "Forty-one Superior Children" follows:[2]

No. 1, Score 166. Father a professional man. Mother a university graduate and former teacher. Maternal grandmother a university graduate and school principal with marked mathematical ability, which is also shown by the child.

No. 2. No record of his heredity given.

No. 3, Score 150. Father superintendent of schools.

No. 4, Score 153. Father a college professor and journalist. Mother a college graduate of unusual ability and musical talent. Several relatives of superior ability.

No. 5, Score 147. A sister of No. 4.

No. 6, Score 144. Father of superior ability. Mother secretary for a large business firm.

No. 7, Score 146. Father, French. Mother, American. Musical family. Great grand uncle was Meyerbeer the French composer. Another uncle is a

[1] Terman, Lewis M. The Intelligence of School Children, chap. xi. Boston, Houghton Mifflin Co., 1919.

[2] The rank of "score" mentioned is the intelligence quotient. The normal intelligence, or average at a given chronological age, is taken as 100.

locally well-known violinist and composer. The child has great interest in medicine.

No. 8, Score 148. Ordinary parents of common school education. Mother somewhat above the average. Distant relatives in high church positions. Dull brother.

No. 9, 10, Score 131, 137. Father a barber. Mother a tailoress. No relatives of more than common school education or superior intelligence.

No. 11, Score 167. Father an able minister. Mother of superior intellectual and personal qualities.

No. 12, Score 159, 158. Father a minister of exceptional ability.

No. 14. No record.

No. 15. No record.

No. 16, Score 139. Nothing given about parents but she has a brother and a sister of marked superior ability. Both are university graduates at 20 and 21 years of age. The sister has done post-graduate work and the brother holds a responsible position.

No. 17, Score 140. Father a college professor. Several relatives of superior ability on both sides.

No. 18, Score 151. Great grandfather was a chum of Abraham Lincoln and a candidate for Senator when he died at 35. A brother of this man was a noted attorney. The father is an attorney; the mother a former high school teacher. Uncles of the mother were political leaders in the early history of Kentucky.

No. 19, Score 142. Father a carpenter of common school education. Mother, a former teacher. There are seven superior children in the family.

No. 20, Score 172. Father a physician. Mother common school education. Several superior relatives and a bright brother.

No. 21, 22, Score 140, 151. Italian children. Parents well educated. Three of grandparents exceptionally bright and well read: one a scientist and linguist, another a talented singer. Relatives of culture and learning on both sides.

No. 23. No record.

No. 24, Score 141. One grandfather a banker; the other a railway official; both intelligent and educated. Both grandmothers well educated and keen. James McNeill Whistler, artist, is a cousin of one grandfather. On the father's side there is an uncle who is a sculptor and painter. Several bright cousins and relatives. The child has talent in art.

No. 25, 26, Score 141, 148. Several relatives of very superior ability.

No. 27, Score 147. Father a mining engineer. Mother a teacher. Grandfather a teacher of superior ability. Uncle is a doctor of divinity and a bright scholar. One cousin of exceptional ability in mechanical engineering; another is one of the best mathematicians Harvard has had for years. Relatives farther back on his father's side are Roger Williams and Colonel Crawford.

No. 28, Score 137. Father a college professor.

No. 29, Score 144. Two uncles on his mother's side of exceptional intelligence. Great great uncle was a doctor of divinity and one of the foremost pulpit orators of his day. There are two bright brothers.

No. 30. No record.

No. 31, Score 141. Father a minister. Maternal grandfather an army officer and graduate of Oxford. Maternal grandmother of musical ability. Of eight uncles on this side two were able lawyers and three were successful engineers. Great grandfather was a prominent Canadian statesman. Paternal grandfather, a college graduate. Paternal grandmother, musical. Only uncle on this side is an expert chemist whose sons show unusual literary ability. Great grandfather was one of the leading spirits in the old Hudson Bay Co.

No. 32, Score 174. Father a jeweler. Mother a milliner. Both have a common school education only. No superior relatives except three remarkable brothers and sisters.

No. 33, Score 150. Both parents are physicians. Mother's relatives chiefly doctors, lawyers, and ministers. Ma-

ternal grandfather a journalist and politician.

No. 34, Score 147. Father a teacher. Mother of marked intellectual ability. Ancestors are farmers of common school education. A distant relative is a lawyer of national reputation.

No. 35, Score 134. Maternal grandfather was an able school teacher. Maternal grandmother a student at 82. Uncles are successful business and professional men. Aunt a talented musician. Mother's brother was a leader of his university class but became insane. Paternal grandfather and grandmother were both school teachers. Uncle, a lawyer and judge. Great grandfather served the longest term in the New York legislature up to this time. One relative is a noted Congregational minister in New York City and another a famous surgeon.

No. 36, Score 146. Both parents of English descent. Father a scientist educator, publicist. The child's two brothers are average, one sister was very superior and another has exceptional ability. A number of superior relatives on both sides. An uncle on the mother's side was an admiral of the United States navy. There are many distinguished relatives on the father's side including Ralph Waldo Emerson.

No. 37, Score 137. Father an able lawyer and a man of more than ordinary ability. There are many prominent relatives including Samuel Adams.

No. 38. No record.

No. 39. Father a lawyer and a graduate of the university at 21. Mother a teacher. Grandparents of average ability. Uncles and aunts average or above.

No. 40, Score 131. Mother a woman of refinement and intelligence, the author of two novels and a number of poems. She wrote essays on sociological subjects at least one of which was published in an English periodical of international circulation. She was an idealist imbued with advance notions regarding religion, sociology and woman's place. The father was an unsuccessful member of a distinguished family. Paternal grandfather was Archbishop of Ireland and dukes and earls are numbered among his cousins.

No. 41, Score 184. Father a Russian Jew. Mother a Polish Jew. Father an advertising man and writer; published three books of fiction. Mother a high school graduate and did some work in a university; has written short stories and poems for various periodicals. Maternal grandfather was a business man of high intellectuality. There are two cases of musical ability on the mother's side, also several distinguished rabbis. Paternal grandfather a business man of unusual mechanical ability fond of making and solving problems. Paternal grandmother taught herself to read English late in life. There are rabbis on this side also.

THE HOME AND THE SCHOOL

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"*One father is better than a hundred schoolmasters.* This was a proverb before the sixteenth century, and do we come out by any other door today? Our vast, complex system of education is failing to educate; twenty-five million boys and girls are at last being standardized in the schools of America with the precision and efficiency of a machine shop; they are primed with information which is assembled just as a Ford car is assembled, and the result is becoming the nation's despair. They know everything and have no sense! Reformers run hither and yon, but there is no ready-made solution that will sove the problem. The home undoes the day's lesson; you must reach the parents; you must educate the adult before you can make any headway with the child; education must begin at home, indeed, what is this conclusion at which we are bringing up but that *One father is better than a hundred schoolmasters?*" (The Villager, April 1922).

One of the active reformers writes:

"The transmission of character and ideals comes best from personal intimate contact of maturity with immaturity, which only a small college can furnish."

Of the need of such contacts before the college stage is reached, nothing is said. Our pedagogues take it for granted that children shall be born and raised, and turned over as raw material to be manufactured in educational institutions. Perhaps the basic fault of our educational system is its failure to recognize the home as the fundamental educational institution, and the parents as the indispensable teachers. The transmission of character and ideals is a fact of human development that needs to be studied from a biological standpoint, no less than other forms of transmission through the germ-cells.

The normal instinct of children is to follow and imitate their parents, as of parents to care for their children. These are the fundamental educational instincts that make human progress possible through the accumulation and transmission of experience from one generation to another. Civilization is the accumulated experience of the race. Longer periods of infancy, childhood and youth permit more experience to be transmitted, and more advanced stages of civilization to be attained. Breaking the contacts between the generations tends to subvert civilization because the experience of children kept by themselves does not go beyond the stage of barbarism. The "youth to youth principle" is invoked by some educators in defending their system, but is a dangerous fallacy that would reduce all the children to the condition of orphans in asylums, deprived of normal contacts with parents and elders.

The basis of character and ability no doubt is organic and hereditary, while the individual attainment is a physiological reaction of the organism to its environment, and is determined very largely by the early post-natal conditions which our present educational system almost completely disregards. Germinal transmission of high intellectual and social qualities is ineffective if the full expression of the desirable characters is prevented by unfavorable environments or bad habits. Every breeder of improved plants or animals knows that favorable conditions must be provided if the full development of desirable characters is to be expected, and that even the best stocks will show inferior behavior under distress conditions.

How many children grow up under conditions of full attainment of possibilities? No farmer could afford to raise a crop or keep a breed of cattle with so large a proportion of failures.

Teachers blame parents for neglect, but schools teach nothing about children or parental responsibility. Thus we reach the paradox that education, in the most general and fundamental sense that relates to the parental contacts, is left out of account by our "institutions of learning." An overgrown school system is disintegrating the family organization of society. To serve as the basis of a genuine, constructive educational reform, the special educational value of the parental contacts needs to be discovered and elaborated, and such information widely disseminated, like our recently acquired knowledge of the wonderful functions of the vitamines of common foods.

Tracing the evolution of our school system may explain this blind spot in our educational eyesight. The system was inherited from Europe, and goes back, as we know, to Mediaeval times, when the only schools were in the monasteries. The decay of civilization in the Roman Empire was so complete that only the monastic institutions survived, where a little of the light of civilization was kept burning through the night of the Dark Ages. Men took refuge from a ruined world and sought in the monasteries a life as far as possible from any interest in the bearing and raising of children, except as objects of pity in orphan asylums, to rescue more brands from the burning. The idea of escape or retirement from the world is still dominant in scholastic institutions. Our universities are "semi-monastic," as an eminent educator has said. Schools of lower rank are faced toward the universities, away from home and family life.

African savages think that they become civilized by putting on clothes, but *our* mediaeval ancestors fell under the obsession of the school, and we still are afflicted with a pathetic belief in going to school as an essential of mental development, notwithstanding all evidence to the contrary. Clothes undoubtedly are useful for some purposes, and schools also are useful, for the purposes that they can accomplish. But savages injure themselves with clothes, and schools have limitations and detriments that need to be recognized and avoided, in the interest of true education.

In recent efforts to make education more practical we have made our schools more like factories, not more like homes. In our mechanically graded schools, with children of the same age and mental development kept strictly together, we have gone to the extreme of denying contacts with parents, or even with older children. A book has been written on "The Artificial Production of Stupidity in Schools," but scarcely makes a beginning of the subject. Ellen Key has a chapter on "Soul Murder in the Schools," with this fundamental indictment:

> "The desire for knowledge, the capacity for acting by oneself, the gift of observation, all qualities children bring with them to school, have, as a rule, at the close of the school period disappeared. They have not been transformed into actual knowledge or interests. This is the result of children spending almost the whole of their life from the sixth to the eighteenth year at the school desk, hour by hour, month by month, term by term. . . . "

It should not surprise us that "our vast, complex system of education is failing to educate," since it is very poorly adapted to the purpose. Yet the system goes on increasing in size and complexity, having a momentum of its own, because we are all trained to believe that the mental development of children depends on the school machinery. "This is what we believe, though we know it is not so," as a Christian Indian said in recounting a heathen tradition. We know that more depends on the home than on the school and that the responsibilities of parents are many times greater than those of teachers. The system provides special schools, examinations and licenses to certify the competence of teachers. Competence of parents becomes a practical concern only as we attain a constructive, eugenic purpose. In the words of the Reverend George Herbert:

> "Studie this art, make it thy great
> design;
> And if Gods image move thee not, let
> thine."

THE BREADFRUIT

A PLEA FOR THE PRESERVATION OF VARIETIES

The Marquesan Islanders Are Rapidly Disappearing, and Will Soon Carry Their Breadfruits with Them to Extinction, Unless Measures are Taken to Preserve the Numerous Varieties of this Useful Tropical Fruit

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MYTHICAL ORIGIN

"IN THE reign of a certain king when the people ate *Araea*, red earth, a husband and wife had an only son whom they tenderly loved. The youth was weak and delicate, and one day the husband said to the wife: 'I compassionate our son, he is unable to eat the red earth. I will die and become food for him.' The wife said: 'How will you become food?' He answered: 'I will pray to my god; he has power and he will enable me to do it.' Accordingly he repaired to the family *Marae* and presented his petition to the deity. A favorable answer was given to his prayer, and in the evening he called his wife to him and said: 'I am about to die; when I am dead take my body and separate it; plant my head in one place, my heart and stomach in another, and then go into the house and wait. When you shall hear a sound, first like that of a leaf, then of a flower, afterwards of an unripe fruit and subsequently of a ripe fruit falling to the ground, know that it is I who am become food for our son.' He died soon after. His wife obeyed his injunction, planting the stomach near the house as directed. After a while she heard a leaf fall, then the large scales of the flower, then the unripe fruit, afterwards one full grown and ripe. By that time it was daylight. She awoke her son and took him out and they beheld a large, handsome tree with broad, shiny leaves loaded with breadfruit."

So, according to tradition in Tahiti, originated the seedless breadfruit, the "staff of life" of the South Sea Archipelagoes.

Paradoxically enough, considering its potential value as an abundant source of nourishing, palatable and wholesome food, there is no tropical fruit today so neglected and of so little actual importance as the breadfruit, for the teeming populations of the Pacific islands whose principal means of subsistance it was, have dwindled to a mere handful.

A PLANT INTRODUCTION ROMANCE

Many fantastic stories have been told about the breadfruit. Byron, for instance, says:

> The breadfruit tree, which without ploughshare yields
> The unreap'd harvest of unfurrow'd fields
> And bakes its unadulterated loaves,
> Without a furnace in unpurchased groves,
> And flings off famine from its fertile breast,
> A priceless market for the gathering guest.

The breadfruit, however, is not a wheaten loaf which may be plucked from the uncared-for forest tree, though it is the nearest approximation thereto in the vegetable world. Solander, who accompanied the famous Captain Cook, and one of the first botanists to see the breadfruit, called it "the most useful vegetable in the world." Indeed, tales of the breadfruit by travellers and pirates of those early days so fired the imagination of the stay-at-homes that the British Government despatched a ship to Tahiti to take the new vegetable wonder to the British colonies in the West Indies, providing what is perhaps the most dramatic incident in the history of plant introduction.

The *Bounty*, a vessel of about two hundred and fifteen tons burden, under command of Lieutenant Bligh, was fitted up for a voyage to the Society Islands and sailed from England in 1787. After crossing the equator the commander steered for Cape Horn

to enter the Pacific, but contrary winds in that inhospitable region drove him back and forced him to sail for Tahiti by way of the Cape of Good Hope. When the *Bounty* at last anchored at Tahiti nearly a year had passed since her departure from England. Six months were occupied in loading the vessel with a thousand breadfruit plants. During this time the enchantment of the island and its beautiful maidens had so captivated the sailors that a month after sailing away they mutinied, placed Lieutenant Bligh in a life boat with eighteen men who had remained faithful to him and returned with the ship to Tahiti. They induced several Tahitian men and women to join them and again sailed away and finally beached the *Bounty* on the isolated island of Pitcairn, where the colony was discovered some twenty years later by an American sea-captain. Lieutenant Bligh, after journeying more than four thousand miles in the open boat, eventually reached Timor in the Moluccas, the most remarkable crossing of the Pacific that has ever been made, and thence found his way back to England. Nothing daunted, the British government again dispatched him on His Majesty's ship *Providence*, to repeat the adventure. This ship left England in August, 1791, reached Tahiti in April of the following year and arrived in the West Indies in January 1793, with about 700 breadfruit plants.

THE FRUIT

The breadfruit is a stately tree, occasionally reaching a height of about 20 meters, with a handsome top of large, dark green, more or less cleft leaves. The fruit grows singly or in bunches of two or three near the end of the branches, is from one to four kilos in weight, roundish to short-oblong in form, and frequently irregular in outline. The surface of some varieties is covered with short, soft spines, while in others it is comparatively smooth and reticulate, the spines being reduced to a series of flat, tubercular projections. The immature fruit is green with white, spongy and fibrous flesh. It is inedible when raw, but when peeled and sliced may be baked, boiled or roasted, then resembling a sweet potato in texture and flavor and serving as a wholesome, palatable, starchy vegetable food.

The surface and flesh of the mature fruit are yellow. It exhales a sweet, rich aroma, so strong that a single specimen fills a large room with fragrance. The flesh is soft and sweet. Peeled and cut into thick slices and baked, it is delicious eaten alone or with cream, still retaining to some extent the rich aroma peculiar to its uncooked condition.

Quiros, the first white traveller to describe the breadfruit declared, "there is no fruit superior to it."

Wallace, the eminent naturalist, said, "With meat and gravy it is a vegetable superior to anything I know either in temperate or tropical countries. With sugar, milk, butter or treacle, it is a delicious pudding, having a very slight and delicate, but characteristic flavor which, like that of good bread and potatoes, one never gets tired of."

The following extravaganza by the famous Captain Cook, probably more than anything else was responsible for the dispatch of the *Bounty:* "Of the many vegetables that have been mentioned already as serving them (The Tahitians) for food, the principal is the breadfruit, to procure which costs them no more trouble or labor but climbing a tree. The tree which produces it does not indeed shoot up spontaneously but if a man plants ten of them in his life time, which he may do in about an hour, he will as completely fulfill his duty to his own and future generations as the natives of our less temperate climate can do by plowing in the cold of winter and reaping in the summer heat as often as these seasons return; even if, after he has procured bread for his present household, he should convert a surplus into money and lay it up for his children."

There are no breadfruit orchards anywhere, and accurate statistics as to

THE BREADFRUIT TREE

One of the most amazing marine adventures in history is connected with sending the *Bounty* to the South Seas to take breadfruit trees to the West Indies. After leaving Tahiti the crew of the *Bounty* mutinied and placed the commander, Lieutenant Bligh, and eighteen members of the crew in an open boat with a small supply of food and water. Thus equipped they performed a successful voyage of 4,000 miles, being at sea nearly a month. They suffered terribly from exposure, as the weather was very bad, and from lack of food and water. Lieutenant Bligh finally became an Admiral, and was always known as "Breadfruit Bligh." (Fig. 18.)

CROSS SECTION OF BREADFRUIT

This fruit is the staff of life of the people among whom it is found. Its importance is indicated by the great number of varieties recognized by the natives, each of which has a special name. In addition to using it fresh the South Sea Islanders have developed a method by which the breadfruit can be preserved for years in what they consider an edible condition. It is placed in pits lined with leaves, and allowed to ferment, somewhat like ensilage or saurkraut. This "kraut" is baked into cakes, relished by the natives, but looked upon by Europeans much as the islanders look upon our cheese. (Fig. 19.)

yield are not obtainable, but it is conservatively estimated that a hectare will yield not less than 25 metric tons of fruit per annum.

Analyses made in Hawaii indicate that 84 percent of this amount is edible, and that it contains approximately 14.5 percent sugar, 9.2 percent carbohydrates other than sugar, and 0.5 percent fat—about the same analysis as the banana except that the waste in the latter is 13.5 percent greater. It is not to be wondered at that the breadfruit became the staff of life of the people among whom it originated.

Notwithstanding its evident value as a foodstuff and the enthusiastic reports of the early voyagers, the extraordinary fact remains that there has been no systematic attempt to study it comprehensively. This is not due to lack of knowledge that the breadfruit occurs in numerous distinct varieties, for this has been known for many years. Besides having economic value, a comparative study of these various forms occurring throughout Oceania would be important in that it might furnish new evidence relative to the migrations of the Polynesians. If it were found, for instance, that varieties growing in the Fijis, the Marquesas, and the Carolines were identical, this would be strong evidence that they had been carried from a common center of distribution.

VARIETIES

The botanist, Solander, who accompanied Captain Cook noted some twenty breadfruits in Tahiti, but his variety list has never been published, and curiously enough, in spite of the interest aroused by the discovery of the fruit, nearly a century passed before the first comprehensive account of it (by Seeman) appeared in print. Seeman, writing from Fiji, recognized there the following thirteen varieties:

Balekana, Bokasi, Buko, Dina, Kalasai, Kio, Koko, Lolo, Varaka, Vonu, Votovoto, Rokouta, and *Sorena*, all of which, except the last, are said to be seedless. Wilkes, of the United States Exploring expedition, stated that there were twenty breadfruit varieties in Samoa, but did not give their names.

Bennett, in "Gatherings of a Naturalist," gives an annotated list of the breadfruits in Tahiti in which he enumerates the following varieties:

Afatu, Anuanu, Aravei, Buero, Faara, Iofai, Maire, Maohi, Ofatia, Opiha, Otea, Oviri, Pafai, Pafara, Paea, Pehi, Peiahuri, Piipiia, Rare, Raumae, Rautia, Roru, Tao, Tatara.

In "The Caroline Islands," 1899, Christian enumerates the following names of breadfruit varieties from that Archipelago:

Apil, Chai, Chaniak, En-chak, Encharak, En-cherrichang, En-kaualik, Enkotokot, En-machal, En-monei, En-paipai, En-pakot, En-par, En-patak, Enpon-chakar, En-po-te, En-put, En-uaoutak, En-ucher, Fanum, Impak, Katiu, Kumar, Kalak, Lipet, Letam, Luathar, Lukual, Nakont, Nan-umal, Niue, Nine, Nue, Paimach, Peau, Pemanthau, Ponpanui, Potopot, Pulang, Tagafei, Taik, Takai, Tal, Ti, Uaka, Yae-reb, Yao-lei, Yao-uat, Yeo-tui, Yoa-tathen, Yong, Yu-goi, Yu-ngalu.

Finally the same author in his book about the Marquesas Islands published in 1910 states that there at least thirty-two varieties of breadfruit in that Archipelago, and enumerates the following variety names:

Auena, Autea, Fafaua, Haapuau, Hetutu, Hinu, Hoi, Kakanokoe, Koka, Koufau, Kuuvahane, Kuukou, Maoi, Maie, Mapua, Movai, Mohomoho, Onape, Orihu, Otai, Piohe, Pipi, Pitaeatae, Piti, Puahi, Pupupi, Takaha, Tapa, Tataatoetoe, Teve, Tioe, Tona, Uea, Vevee.

In "Polynesian Researches" Ellis states that the missionaries were acquainted with nearly fifty varieties of which he had the names, but unfortunately he failed to enumerate them. He says "In the Marquesas the breadfruit probably attains greater perfection than elsewhere."

There are doubtless synonyms in each of the above lists published by Christian, and were varieties from the different archipelagoes brought together it would probably be found that some, at least, of those from different island groups are also identical. Allowing for errors and synonomy there are probably some thirty-five distinct breadfruit varieties in the Pacific Archipelagoes.[1]

ORIGIN

Where did these varieties originate, and when? An interesting problem.

The seedless breadfruit was first seen in the Marquesas by Europeans in 1595 and successively found in many forms in the other Pacific Archipelagoes as they were discovered. In the Malay Archipelago the tree was first noted by Rumphlius not earlier than 1653. At that time the breadfruit was found only in the east and southeast of the Dutch East Indies. Even yet the breadfruit is of but little importance in that region, and in a recent work Heyne records only two varieties (in Madura). The earliest record of the breadfruit in the Philippines, that of Camello, who arrived there in 1688, apparently refers to a fruit recently

[1] While this article was in press I received from Mr. Howard F. Withey, American Consul in Tahiti, a list of 52 breadfruit varieties in the Society Islands, of which 27 are described, and a descriptive list of 25 varieties from the Marquesas. Mr. Withey writes: "No other fruit in these regions yields so much per acre. With one exception all varieties are seedless. As a food there seems to be but one criticism of the breadfruit, i. e., that it does not keep well.—"P. J. W.

FRUIT, LEAVES AND FLOWERS OF THE BREADFRUIT

The male flower is on the right, the female in the center and an immature fruit on the left. The varieties used by the South Sea Islanders are nearly all seedless, but seeded varieties exist, and the seeds are eaten like chestnuts. Both kinds are considered to belong to the same species. In addition to its value as a food plant the breadfruit furnishes a fibre for making bark cloth, and timber highly valued for boat building. (Fig. 20.)

introduced from the Marianes by the Spaniards. Blanco's statement that the seedless breadfruit occurs spontaneously in Leyte (Philippines) may be safely discounted.

It would appear probable that the first seedless forms originated somewhere in the islands immediately east of Java or in the Moluccas, and were thence carried eastward by the Polynesians in their migrations. As the plant assumed greater importance as a food staple and became generally grown, it is probable that new varieties in the form of bud sports appeared from time to time. This belief is strengthened by the fact that while in Oceania there are myths purporting to explain the origin of the breadfruit, so far as the writer is aware there are none in the folk lore of the Malays of the Sunda Islands.

PROBABLE EXTINCTION

In "White Shadows of the South Seas" Frederick O'Brien says that the days of the Marquesans are numbered. In an article in the National Geographic Magazine for October 1919, J. W. Church corroborates this, and says that his census of that year found only 1,950 people alive in the Marquesas, and that in the five preceding years the population had decreased more than 33 per cent, and that ten years thence there would not be a full blooded Marquesan alive. Once populous valleys are already swallowed up by the tropical jungle.

It is a well-known fact that cultivated plants can not successfully compete with the wild vegetation when the protecting arm of man is removed. And as the Marquesan is doomed to extinction, so will his breadfruits—by travellers described as superior to all others of their kind—inevitably follow if man does not intervene. Some of these varieties may have become extinct already or be near extinction. In the Society Islands the situation is but slightly better. While the disappearance of some of the breadfruits would be an economic loss, there would be, in addition, the sentiment of the loss of that which has been the staff of life of one of the races of man which our own civilization has destroyed. Nor should it be forgotten that, although in the sciences and trades a lost art or a lost invention may be rediscovered, in the plant world this is not so, for when the last individual of a species or a variety has passed away it is irrevocably lost. Again, for all that has been written about the breadfruit and the multiplicity of its forms, the curious fact remains that not more than three varieties appear to have found their way from the South Sea Archipelago to other lands. Finally, as has already been stated, the gathering together of the breadfruit varieties in the Pacific Archipelagos for a comparative study should add further evidence relative to the much mooted question of the migrations of the peoples within those regions.

A WAY OUT

Might not the great world powers with tropical possessions unite to save the many kinds of this interesting and useful plant from extinction? Could not a trained agricultural explorer familiar with the tree be sent to bring its superior varieties from the remote South Seas to other parts of the tropics where they might thrive under intelligent care? And would not the financing of such an adventure be a benevolent enterprise which should appeal to the imagination of some philanthropist intent on serving his fellow men?

"THE MANNER OF MAN THAT KILLS"

A Review

THIS[1] is "the history of three crimes which might have been prevented, crimes which were inexcusable and a disgrace to our country. Society here punished the person it created. The original fault was the fault of society. Society, upon whom rests the responsibility, should be arraigned at the bar of Justice and put on trial and convicted instead of its product."

Bertram G. Spencer terrorized Springfield, Mass. for nearly two years, beginning in June, 1908, with a series of burglaries which had no apparent motive. In the course of one of them he shot and killed a young woman. He was finally caught, and committed for observation to a hospital for the insane. All the alienists who examined him pronounced him a defective from birth. His history from childhood itself showed that he was not a safe person to be at large in the community. But he was allowed to go unguarded until for two years he gratified his longing for sensation by daring burglaries and in a crucial moment lost control of himself and committed a murder.

After being kept in the hospital for about a year he was returned to Springfield for trial, as the result of what Dr. Briggs considers political influence, and was convicted and put to death.

The second case with which Dr. Briggs is concerned is that of Leon Czolgosz, the so-called anarchist who shot President William McKinley at Buffalo in 1901. In connection with the trial of this murderer, "no thorough, scientific investigation or study had been made of his mental or physical condition previous to his arrest." Public opinion demanded speedy vengeance, and there was apparently little desire on the part of the authorities to be "embarrassed by facts." Allan McLane Hamilton, an alienist who was called to Buffalo to examine the prisoner, was not allowed to make an examination, but he was permitted to attend the trial, and in his *Autobiography* declares, "I really do not think that in all my experience I have ever seen such a travesty of justice." Shortly after the execution of Czolgosz, Dr. Briggs undertook an investigation of the case, which satisfied him that "President McKinley was killed by a diseased man, a man who had been suffering from some form of mental disease for years. He was not medically responsible and in the light of present day psychiatry and modern surgical procedure, there is a great question whether he was even legally responsible for the death of our president."

Rev. Clarence V. T. Richeson, the third of Dr. Briggs' subjects, was the pastor of a Boston church who furnished *cause celebre* to the newspapers in 1911. He "was, I think, the only man ever executed in Massachusetts without a trial. He was a victim of hysteria with delusions, hallucinations, amnesic periods, and delirium. He had exhibited signs and had had attacks of this disease for years, had been recognized as mentally unsound by several physicians who advised specialists in mental diseases to attend him. Still, he was allowed to 'carry on' until his acts resulted in the death of a young girl in this state." He eventually confessed, and was executed.

The life histories of these three men are given at great length. In spite of some tiresome irrelevant detail, they make reading of such interest that almost any devotee of the stories of crime turned out by professional fiction writers would find them worth while.

The judicial killing of such men as those described is a rough and cheap sort of eugenic procedure, from which the race in the past has undoubtedly

[1] *The Manner of Man that Kills*, by L. Vernon Briggs, M.D., director of the Massachusetts Society for Mental Hygiene. Pp. 444, with 19 illustrations. Boston, Richard G. Badger, 1921.

derived benefit. But the time has passed, Dr. Briggs thinks, when it is the most useful method of treatment. "When we find a germ that kills people we do not annihilate it so that it is impossible to learn more about it. No, we put it under glass, nurse and study it under different conditions, find out its characteristics, its source and how it develops, so that we may be able to combat other germs of the same kind and render them at least harmless." So far as the individual murderer is concerned, the author argues that he should be turned over to men of science for study which would certainly benefit society more than the present execution of the convict does.

But Dr. Briggs' principal interest is in the prevention of such crimes. Altogether apart from the humanitarian side, the mere financial cost of the present system is excessive. It was estimated that for 1921 in the state of Massachusetts alone support of the institutions for the feeble-minded and insane would cost \$8,400,000; payments for the Department of Public Welfare \$4,500,000; for Department of Health \$1,500,000; and Department of Corrections \$1,400,000, making a total of \$16,000,000, or 40% of the total annual expenditure of the state, devoted to the defective, dependent, and delinquent classes.

As has often been pointed out, the fundamental solution of this problem is the institution of such eugenic measures as will keep a large part of the "three D's" from being born. Dr. Briggs is little concerned with this solution, although in the heredity of the cases under consideration—Spencer, Czolgosz, and Richeson—there is abundant evidence of genetic defect that could hardly produce anything but trouble.

Granted, however, that something more than eugenics is needed to meet the present emergency and to deal with the existing generations, the author urges that "there is no excuse for any community not taking measures to recognize mental disease during its earliest manifestations. We should recognize the defectives not only in the schools but earlier, and then apply the remedy and not cease diligently to use all scientific means to cure mental illness before the disease becomes chronic, and so to direct and train the mind of the defective that he will at least become if not a useful, then a harmless member of society. In either case we must protect these individuals and the community from any harm consequent on their defectiveness or disease by directing their lives, if necessary, in hospitals and schools."

"Invariably an early study of the personality of these individuals will reveal certain character traits such as jealousy, cruelty, suspicion, egotism, negative self-feelings, false pride, etc., which unless recognized and corrected while their minds are still plastic will eventually lead to paths which will prevent them from making the proper adaptation to their environment, the results being crime, pauperism, mental, and physical disease.

"On the other hand if these same instinctive forces be guided and directed and perhaps the environmental factors altered, and mental and physical occupation selected to suit each case, an avenue would be established which would take that individual out of chaos into a useful and happy life."

"Some have undoubtedly been born without any sense of moral responsibility in their make-up, and a very large number have been warned by environment. Is it right to punish these individuals?"

"The alleged excuse for law is that it will act as a deterrent. It does not so act with the classes we have under discussion. It did not so act with these three individuals whose histories I have written." It is now well known that the minds of many criminals "are often of such a calibre that the fear of punishment does not deter them. With minds so primitive that they do not understand or fear death, or so diseased that they do not appreciate

the consequences of their acts, these people go on unmolested until they commit some deed which is followed by disaster and suffering. Does not all this prove that we have not the remedy in law?

"I believe we have it in scientific study and investigation, in psychopathic hospitals and dispensaries properly supported by government and community, both financially and morally, and by proper rules and regulations of society which will protect the community."

In addition to training schools and custodial institutions, the specific measures which Dr. Briggs advocates are:

1. That license to practice medicine be granted only to those who shall have passed an examination in psychiatry.

2. That all physicians be required to report to the state Department of Mental Diseases, confidentially, every known or doubtful case of mental defect or dangerous form of mental disease.

3. That "if after receiving the report of any particular case the Department of Mental Diseases believes that the said case is not receiving proper care and treatment, it may make such recommendations to the attending physician or other persons in interest as the welfare and safety of the person afflicted and of the public may require."

4. That the distinction between medical and legal insanity be abolished in chronic cases, if not in all cases.

5. That when a recidivist comes up in court, the Department of Mental Diseases shall be notified and shall cause the defendant to be examined and a report on his mental condition filed to be used as evidence. "This would in no way interfere with the rights of the individual to employ experts, but it would tend to settle all questions so far as the state is concerned and prevent the deplorable condition which now exists in so many cases where our medical men are apparently pitted against each other and are held up to ridicule."

Certainly something should be done with the class of offender who comes into court time after time. It was found in 1918 that of 11,495 persons committed to Massachusetts penal institutions during the year, 6,733 or 58.5% were repeaters. "It further appears from the same tabulation that they averaged 6.8 former commitments each. In the 21 county jails and houses of correction 5,727 of the 9,719 inmates entering these county institutions during 1918 were known to have served time before, and the number of sentences served by these repeaters totalled 40,288. The records of these repeaters in county jails showed that 25 or more previous commitments was not uncommon, while some institutions housed men with as many as 100 terms of confinement against them."

Such a record shows clearly that the present machinery—judicial machinery—for dealing with such individuals is inefficient if not useless. One can hardly help agreeing with the author that the effort to treat mentally diseased persons by sentencing them to a term in jail is an anachronism, and a dangerous one.

Whether the reforms proposed by Dr. Briggs would go far toward solving the problem is open to question. The constant appearance in court of eminent medical specialists, doubtless sincere, testifying on opposite sides of a case makes the layman have less confidence in the omniscience and infallibility of psychiatrists than Dr. Briggs' recommendations suggest. But unquestionably much could be gained by greater activity of competent psychiatrists; much could be gained by changes in the Public educational system; much could be gained from the better education of parents. Perhaps still more is to be expected from changes in the birth-rate of different parts of the population.—PAUL POPENOE, *Coachella California.*

RED-GREEN COLOR-BLINDNESS IN THREE ALLIED FAMILIES

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THIS small piece of research was undertaken with the purpose of discovery, if possible, the source of red-green color-blindness in the family numbered 1 in the accompanying chart. The quest was unsuccessful; but in its pursuit enough cases of color-blindness were found to make it seem worth while to put the facts on record. I wish to take this opportunity to thank Prof. Leon J. Cole of the University of Wisconsin, Prof. Edwin G. Conklin of Princeton University, and especially Dr. Howard J. Banker of the Eugenics Record office at Cold Spring Harbor, New York, for their kind suggestions and criticisms, as well as numerous members of the families under consideration for their courtesy in answering questions.

In the accompanying chart I have designated males by squares and females by circles; color-blind individuals by black; carriers of color-blindness by stripes; carriers according to theory by shading, normal color-vision by N, individuals about whose vision nothing is known by white, and suspected color-blindness by a query.

It will be convenient to begin by considering the case of Family 1, Generation IV, individual No. 1, whom, for brevity, we shall call IV. 1.

IV. 1, was a professor of physiology and an authority on the physiology of vision; he wrote the section on this subject in the American Text Book of Physiology (1896). He was red-green color-blind and was much interested in the subject but I have been unable to find out that he knew how the defect descended to him. He had two brothers with normal color-vision, and three sisters, of whom two died unmarried and the third is represented on the chart as IV. 2. IV. 1 had two sons, both with normal color-vision, and five daughters; of these, two have no sons; one, V. 1, has three daughters and one son, VI. 1. who is color-blind, and the two others, V. 2 and V. 3, twins, have each two color-blind sons, VI. 2 and 3, and VI. 4 and 5 respectively. V. 2 has in addition one daughter and three sons whose color-vision is normal.

IV. 2 had one daughter and three sons; the daughter has a daughter, and of the three sons, two are color-blind, V. 4 and 5. V. 4 has a daughter, VI. 6.

IV. 1 must, according to the rule, have derived the defect from his mother, III. 2; and as it is known that her husband, III. 1, had normal color-vision, it is clear that IV. 2, also derived her color-blind carrying capacity not from him but from the mother, III. 2.

IV. 4, who was first cousin to IV. 1 and 2, was color-blind; his brother, however, is a successful painter; there are two unmarried sisters; and a married sister, IV. 3, who has had two daughters and a son with normal color-vision, and two sons, V. 6 and 7, who are color-blind. IV. 4, like IV. 1, indicates that his mother, III. 3, was a carrier, and her husband having had normal color-vision, it is evident that V. 6 and 7 get their defect through their mother's mother, III. 3.

III. 2 and III. 3 were sisters; they had a brother and two sisters who died single, and had the brother been color-blind it would have been known to IV. 1, who lived near his uncle and saw much of him. Had this been so, we might safely have attributed the defect to the mother, II. 2, but as it is we can say only that the sisters III. 2 and 3 got the defect either from a color-blind father, II. 1, or from a carrier mother, II. 2. From which of these it comes is the point I have failed to elucidate.

II. 1 was a lawyer, well known in Salem and Boston, and he lived until 1848, eight years after the birth

of his grandson IV. 1. IV. 1's mother mentions his color-blindness in a number of her letters, and had her father been color-blind it would seem not improbable that she would have mentioned the fact and hence that IV. 1 would have known whence the defect came. The only hint I have found is that a great-grandson of one of the brothers of II. 1 thinks that he remembers some stories suggesting color-blindness told about one of his great-grandfather's brothers, and attaches them in his mind to II. 1, but this is too vague to build on.

Hoping to find the defect among the descendants of II. 1's brothers I have entered into correspondence with a number of people, without success. II. 1 had six brothers and two sisters; four brothers and one sister died without issue; of the other two brothers neither had daughters who left children, and the remaining sister married her first cousin (her mother's sister's son) by whom she had two sons and a daughter; one son died at the age of four and the other, who has left three generations of descendants with normal vision, was not color-blind. Without going into further details, suffice it to say that I have gone back another generation, to the mother of II. 1 and her brothers and sisters, as well as ascertaining that her uncles and aunts all died without issue.

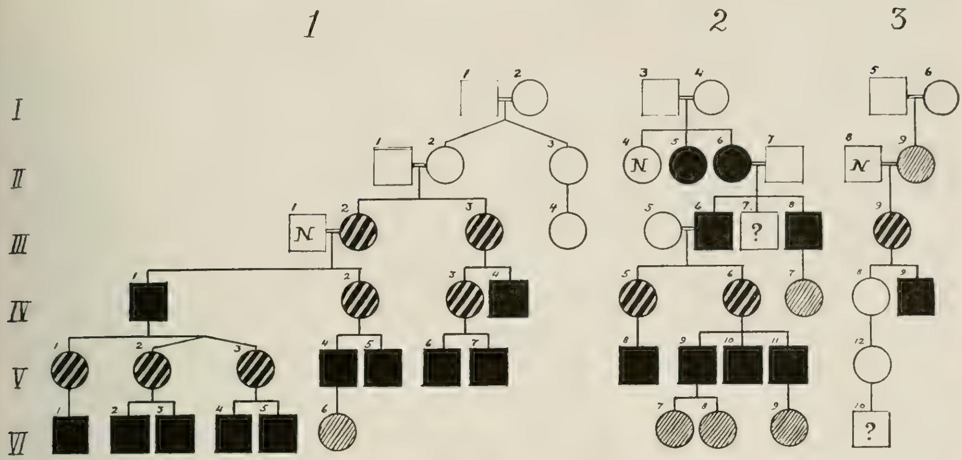
Having failed to find the defect in the family of II. 1 I turned my attention to that of his wife, II. 2. She was one of a pair of twins, only daughters; and I hoped to find the defect among the descendants of her sister II. 3. II. 3 has a single child, a daughter, III. 4, who married and had seven daughters and three sons, of whom two have normal vision, and the third had marked talent as a painter, so could hardly have been color-blind; in short, there has been no color-blindness among three generations of descendants of III. 4.

Whether or not III. 4 was a carrier, her mother II. 3, may have been. She and her twin sister II. 2 were the only daughters of I. 1, an officer in the Continental Army, who when offered the positon of adjutant-general at first declined it partly on the ground that his defective eyesight did not allow him to "survey distinctly a wide or distant area. He had experienced this defect from early life." (Quoted from his Biography.) The mere fact of color-blindness was not recognized until about the period of the Revolution so it is not surprising that his defect, if it was color-blindness, was spoken of as "near-sightedness." This officer, I. 1, wore spectacles, at that time a rarity, and was dependent upon them, an argument against color-blindness being the sole cause of his disability. About his wife's (I. 2) family I know little.

To summarize: Family 1 shows red-green color-blindness occurring in the males of three generations and following the well-known rule of transmission.

Family 2 is of greater interest than Family 1 in that we find two cases of female color-blindness. II. 4, 5 and 6 were sisters, II. 4 and 6 married and II. 5 unmarried. Both II. 5 and 6 were color-blind, but II. 4 was not and according to the rule their father, I. 3 must have been color-blind and their mother I.4 a carrier, but I have not indicated I.3 as color-blind on the chart because his was not a known case. I have been unable to get any information about other descendants because, so far as I can find out, the two brothers and five sisters of II. 6 died without issue, nor do I know whether any of them, besides II. 5 and 6 were color-blind; but according to the rule half the sisters and half the brothers would be color-blind, and the sisters who escaped would be carriers, supposing that I. 3 were color-blind and I.4 a carrier.

II. 6 had three sons and no daughters. We know that two sons, III. 6 and 8 were color-blind, and no doubt III. 7 was also, for the offspring of a color-blind woman show 100% defectiveness, color-blindness in the males, carriers in the females. III. 7 had an only child, a son, in whom the defect would not be expected to appear; he is childless.



COLOR-BLINDNESS IN ALLIED FAMILIES

Color-blind individuals are designated by black; carriers by stripes; carriers according to theory by shading; normal color-vision by N; and those about whom nothing is known by white. Normal members of the family are not shown in the chart. III.6 and III.8 married sisters of III.1 in family I, a curious coincidence of three members of one family marrying consorts of color-blind stock. (Fig. 21.)

III. 6 and III. 8 married sisters, who were the sisters of III.1 in Family 1. We thus have the curious coincidence of three members of one family marrying consorts of color-blind stock.

III. 6 had five daughters and one son. All five daughters must, according to the rule, be carriers, but two are without children and one has a son with normal vision and a daughter who has no sons; so that the defect is transmissable (to date) only through two daughters, IV. 5 and 6.

IV. 5 has two children, both sons; one has normal vision; the other, V. 8, is color-blind and has had no children.

IV. 6 has six children, three sons and three daughters. All three sons are color-blind, V. 9, 10 and 11; of these one is unmarried, one has two daughters VI. 7 and 8, and the other has one, VI. 9; these three granddaughters of IV. 6 are still in their childhood, and must be looked upon as carriers. IV. 6 has, as was stated, three daughters who are potential carriers; one is unmarried, but the other two have respectively four and two sons, all with normal vision.

III. 8 had two sons and two daughters. One daughter died unmarried, but the other, who must be looked upon as a carrier, IV. 7, had a son with normal vision, and a daughter who has had three sons, two of whom have normal vision and the third is too young to be tested.

To summarize: Family 2 starts with a color-blind woman (II. 6) and the rule of transmission is followed in that it occurs in two sons (and, for all that is known to the contrary, in the third as well), thence descending through females to males; but in this family we have no instances, as in the first family, of transmission through two female generations before it reappears in a male.

Family 3 has a short chart. II. 8 died in 1891 and his daughter, III. 9 is now living at the age of eighty-one. I rely upon her opinion for marking her father as having normal color-vision, for it seems as though such a defect could hardly have been unknown to her. She had two sons, one with normal vision, the other color blind, IV. 9; he has no children. III. 9 is therefore a carrier, and it appears safe to say that the defect came to her through her mother, a Virginian, whose family I have been unable to trace, owing, probably, to the destruction of the records in Petersburgh during the Civil War.

III. 9 has also had two daughters, who may be carriers; one is the mother of one daughter, still a child; the other, IV. 8, has one son with normal color-vision and has had six daughters of whom two have married; one has no children, the other, V. 12 has one daughter and one son. This boy, now over three years old, is as yet unable to tell the names of colors correctly and is therefore marked with a query, as it may be that the trouble is confusion of names rather than of colors. The alliance comes about in this way: V. 12 is the wife of a son (not shown on the chart) of IV. 1, (Family 1) VI. 10 being therefore a grandson, and possibly another color-blind grandson (though if so not by inheritance from his grandfather) of IV. 1.

Conclusion: The study of color-blindness in these three families, although it brings out nothing new, illustrates the truth of the accepted law of inheritance of the defect.

TWINS REARED APART

Paul Popenoe,
Coachella, California

SINCE Francis Galton's pioneer researches, twins have been regarded as offering particularly favorable material for the study of environmental influence on inherited traits. A crucial case, because of the dissimilar environments in which the twins were reared, was recently called to my attention by Dr. Mary Lawson Neff, of Phoenix, Ariz.

A family named Irwin, living in a small town in the Black Hills, had three children—two sons and a daughter. Twin girls were then born. The mother never recovered strength, and died eight months afterward.

The twins, Jessie and Bess, were adopted by two families who lived on ranches. The former (now Mrs. Carl G. Sanders, a school teacher in Arizona) has kindly given me particulars of their upbringing.

Following their separation at the age of eight months, the two girls did not see each other, nor did they correspond, until they were 18 years old. In their entire lives, the twins have been together only two months in 1911, two months in 1913, and six months in 1914. They have now not seen each other for seven years.

Their history is outlined by Mrs. Sanders as follows:

Bess lived with her foster parents on the ranch until she was five years old, when they quit ranching, traveled overland for two years, visiting Canada in the course of this travel, and finally settled in Helena, Mont. Bess went to the public school there until she finished the fifth grade, then entered business college, and at the age of 14 went to work in an office. She has followed a business career ever since. From 14 to 18 years of age she was with the forest reserve administration, 18-22 Montana Life Insurance Company, later in New York as extension student at Columbia and secretary to the president of a publishing company. At the beginning of the war she joined the Food Administration in Washington, then went to France with the Red Cross, transferred to the Graves Photography Bureau, returned to Washington, and then to Helena. She has clerked in two state legislatures in Montana and spent several summers doing clerical work in Yellowstone Park.

Jessie, on the other hand, went to a rural school and then through high school, started to train as a nurse, had a physical breakdown, later taught school three years, married in 1915, gave birth to a son in 1916, did some open air work in subsequent years, and in 1920 began teaching again.

The physical likeness of the two is close. The two, according to Mrs.

THEY STILL LOOK ALIKE

Growing up in different environments has not made these twins look very different, and according to the evidence presented, they still think as much alike as they look. Their hair and eyes are the same color, and their weight is always very nearly the same. This case offers further evidence that the psychical makeup of the individual is largely settled by the time he is born. (Fig. 22.)

Sanders, are of exactly the same height, and nearly always weigh within a few pounds of each other. When they have been together, they have worn each other's clothes perfectly and friends found their voices indistinguishable. Their hair is identical in color, and few people can tell them apart. Mrs. Sanders' son has never seen his aunt, but cannot distinguish her photograph from that of his mother. Both have weak lungs "and have been run down from that cause, and nearly always at the same time."

"I am very sorry," the narrator continues, "that I cannot remember exact dates of illness, but many times our letters bearing word of enforced idlenesses have crossed, until we began to expect to hear of the other's illness as soon as one of us was indisposed."

The mental similarities are perhaps less to be expected than the physical resemblances, but are no less striking. To quote the informant:

"It is almost uncanny, the way we are always doing identical things at the same time. The latest instance is in having our hair cut, each without the other's knowledge. This really took courage, because the majority of our friends do not approve.

"We are both high strung and do not seem to conserve our energy as we should, but I have been resting more gracefully this summer than I ever have before, and in her latest letter she expresses the same mood.

"I believe (and of course say this without conceit) that an intelligence test would find our capacities very similar, and I surely would like to try the experiment if the opportunity presented itself.

"We both favor history, social study 'that functions,' and politics. Neither of us cares for mathematics, and I would not call either of us a good student. We are too 'smattery,' although we learn rapidly and with very little effort.

"I might add that we both seem to show some administrative ability, because we invariably hold an office in every organization we affiliate ourselves with. Last year I was treasurer of our state teachers' association, and am chairman of two county committees now. The latest letter from Bess advises that she has just been elected president of the women's division of a commercial club.

"We have never had a disagreement between ourselves, and while I am fond of my older sister and two brothers, yet they have never seemed as close to me as Bess."

It is related of the Siamese twins that if one was touched at night, *the other one* would waken and inquire what was wanted. Such mental similarity in two individuals brought up together is striking enough. But when two individuals are separated in infancy, brought up as differently as are the twin sisters described above, and still manifest such mental similarities, it is impossible to resist the conclusion that the psychical make-up of the individual is very largely settled by the time he is born.

The

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A FLOCK OF CANADIAN CHANTECLERS

FRONTISPIECE. The picture was made on the grounds of the poultry plant at La Trappe, Canada. This is another breed "made to order" to meet a special set of conditions. The method used was to mix together the various desirable ingredients, and sift out the qualities needed by means of "the sieve of selection." The purpose in creating the breed was to get one eminently fitted to Canadian conditions; all fancy characters were eliminated, especially those that were considered undesirable. It was to be an all-purpose breed: a good winter layer, and heavy enough to be useful for meat as well. (See text, p. 148.)

CHANTECLER POULTRY

A New Breed of Poultry—Developed to Meet the Winter Conditions of the North[1]

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IT IS a surprising fact that, although most of our breeds of animals are of relatively recent origin, the exact way in which they have been originated is known in but a small number of instances. In earlier times many breeds, like Topsy, "just growed" until they came to have general recognition; then standards were formulated and special societies organized by their admirers. In more recent years several breeds of poultry have been produced in which the process has been a more deliberate one, or at any rate, in which the records have been more adequately preserved. One of these, the Lamona, has been fully described in this JOURNAL,[2] and it may therefore be appropriate to follow this with another, which has been named "Chantecler." This new "creation" in the poultry world is of interest because of its type and the purposes it is meant to serve; but not the least of interest in connection with it are its place of origin and the circumstances connected with it.[3]

Just north of St. Anne de Bellevue in the Province of Quebec the Ottawa River, before sending its four arms reaching out for the St. Lawrence, widens into the picturesque Lake of the Two Mountains. Both village and lake are famous in the annals of the early French explorers and fur traders. On the north shores of the lake are the two "mountains" which served as unmistakable landmarks to the *voyageurs*, and from which the lake received its name. They are, in reality, two large rounded, wooded hills, one towards either extremity of the lake. Nestled in the saddle between them, in an atmosphere of quiet seclusion and medieval picturesqueness, is a Trappist monastery, the silent monks in their striking dress, engaged in their labors and devotions, adding a touch of realism to the picture. Here, too, one meets a cordial welcome, and a truly medieval hospitality. Connected with the monastery, and under the able direction of Father Leopold, is the Institut Agricole d'Oka, one of the two Agricultural Schools for the French speaking population of the Province which receive Government aid. The school, which is at a little distance from the monastery, is incongruously modern in appearance, and tends to dispel the impression of medievalism that one might have formed. Any such impression is entirely destroyed when one goes into the thoroughly up-to-date dairy barn and looks over the excellent herds of Ayrshire and Canadian cattle, or when any of the other farm practices are inspected. In all these is a modernism that is entirely at variance with the first-formed impressions of the place.

In a beautiful little valley near the monastery, with a rushing mountain brook tumbling through it, is the poultry plant, presided over by Brother Wilfrid, who is the poultry husbandman of the Institute. Here, then, is the cradle of the "Chantecler." It is a delightful setting, but from a purely practical standpoint the land in the valley is rather too low and damp to be ideal for poultry.

Brother Wilfrid states that his purpose was to create a purely Canadian breed, and one that should be eminently

[1] Papers from the Department of Genetics, Wisconsin Agricultural Experiment Station, No. 35.

[2] LAMON, HARRY M., Lamona—A New Breed of Poultry. *Journal of Heredity*, XII:1–29. 1921.

[3] The facts used in this account are in part from a small pamphlet by Fr. M. Wilfrid, *Standard, Origin and Monography of the Canadian 'Chantecler,'* La Trappe, P. Q. 1919, and in part from a recent visit at La Trappe by the writer. The breed has also been noticed in the *Reliable Poultry Journal* for December, 1921.

practical for Canadian conditions. To this end he desired to eliminate as far as possible all purely "fancy" characteristics, especially such as might be disadvantageous. He was, he states, "aiming at something more practical than mere outside appearance to please the eye." Having had experience of the danger of freezing of combs and wattles in severe winter weather, he determined to reduce these to a minimum. As for color, white was decided on, though he does not state whether he believed this color has any economic advantage over others. Doubtless the fact that most other colors and patterns require much selection to maintain was a factor in this decision. Beyond this the new breed was to be a general purpose one; the hens should be good winter layers, and still the type should be such that it would serve well for meat purposes. "My ideal being fixed," he adds, and "knowing what I desired, but not possessing the power of creating something from nothing, I considered a judicious crossing of the best breeds, as far as eggs and flesh were concerned, was the best course to venture." In other words, he adopted the obvious method of mixing together the available ingredients of his new breed, and then by the sieve of selection, straining out the combination desired.

In casting about for the desired qualities the Cornish was selected as the starting point, since it seemed to possess to a high degree the general conformation, vigor, and type of comb and wattles desired. For high laying qualities the White Leghorn offered obvious material, while the Rhode Island Red, Wyandotte and Plymouth Rock it was thought might help winter egg production.

The first crosses were made in 1908, a dark Cornish being bred to White Leghorn hens in the one instance, and a Rhode Island Red cock to White Wyandotte hens in the other. It is stated that "the hens in these first two crosses are white," though this is modified by the further statement that the first mating gave "a bird of a grayish colour, with feathers very short, closely set to body, and of slender shape, whilst the head showed neither comb nor wattles." In the Rhode Island Red by Wyandotte cross the white is said to have dominated, but "with a splashing of gray and black," while among them was a "beautiful cock, a real Columbian Wyandotte." It is difficult to reconcile Brother Wilfrid's results in this latter cross with those of other experimenters, who have found the white of the Wyandotte to be recessive.[4] Brother Wilfrid is convinced of the truth of the dictum that "the female gives the colour and the male the shape," though it must be pointed out that by many poultry breeders exactly the opposite is claimed to be the case. Genetic experiments have proven that in most cases the color has no relation to sex in inheritance and such a relation to type has not been substantiated.

In succeeding years various crossings were made, but selection was always towards the desired type. In 1909 the whitest pullets from the Cornish-Leghorn cross were mated to the cock from the other cross which resembled a Columbian Wyandotte. This gave a variety of color and type,—some were dirty-gray, some speckled, while in general character some resembled Leghorn, some the Rhode Island Red, and others the Cornish. The latter type predominated. The following year (1910) a White Plymouth Rock was crossed in, a fine 9¾ pound cock being mated to the pick of the previous year's pullets. This cross improved the color, but the results were otherwise disappointing. Continuation of the selection, however, began to tell in the following two or three years, by which time "the colour was almost uniform, the laying capacity had increased considerably, the comb and wattles were disappearing and the birds had proved to be very vigorous and active."

[4] See for example, LIPPINCOTT, Further Data on the Inheritance of Blue in Poultry, *American Naturalist*, LV:289–327. 1921.

THE BIRTHPLACE OF CHANTECLER

FIGURE 1. This new poultry "creation" was developed by Brother Wilfrid, a Trappist monk in charge of the poultry department of the Institute Agricola d'Oka. This school is one of the two agricultural colleges receiving government aid that are available for the French-speaking people of the province of Quebec. It lies in a beautiful valley between the two wooded hills that give name to the Lake of the Two Mountains, a picturesque region whose history is linked with the thrilling adventures of the early trappers and explorers. (See text, p. 147.)

In 1913 a somewhat different method of breeding was inaugurated. The birds were divided into two flocks, in one of which inbreeding was practiced to a certain extent, while a Wyandotte cock was used with the others. Selection continued to be effective, and by 1916 Brother Wilfrid felt that he had nearly reached the end he had been striving for, except that his birds were not quite up to his desire in weight and fleshing quality. One exceptional pullet, however, in 1916 weighed 7¾ pounds at seven months of age and produced 91 eggs in the four months from November 1916 to February 1917. This pullet was bred to a White Plymouth Rock cock and the finest cockerels from this mating were used to head the two flocks.

Brother Wilfrid admits that there has been and still is "atavistic" tendency, but this is naturally only what is to be expected in a breed of such recent and mixed origin. The uniformity is such, however, that the "Chantecler" was recognized as an established breed by the American Poultry Association in August, 1920, and admitted to a place in the "Standard of Perfection."[5]

[5] The confusion which arises from the formation of a multitude of breeds by different combinations of a limited number of characters is strikingly illustrated by remarks of Mr. John H. Robinson in the *Reliable Journal of May*, 1922, where he refers to the "Babel of Breeds," in a discussion of the work of the Revision Committee of the American Poultry Association. With a reference to the Chantecler he says:

"Something very like a shiver went through the Revision Committee as the members, when considering the Standard for the Chantecler, made the discovery that there is such an amazingly close resemblance in the ideal illustrations of the Chantecler, male and female, submitted with the petition for its admission, and the ideal illustrations of Buckeyes in the 1915 Standard that the Chantecler could be described as a White Buckeye with a 'cushion comb' instead of a 'pea-comb.' "

CHANTECLER AND HIS WIFE

FIGURE 2. The parents of this all-Canadian breed are the Cornish, the Leghorn, the Rhode Island Red, the Wyandotte and the Plymouth Rock. The first crosses were made in 1908; the breed was recognized by the American Poultry Association in 1920. There is still considerable variation, as would be expected in a strain so recently developed, and of such varied ancestry. Note the heavy plumage, and the small comb and wattles, both characters of great importance in withstanding the severe Canadian winters. (See text, p. 148.)

In a casual inspection the "Chantecler" shows strongly the Cornish contribution to its ancestry. Not only is this apparent in the comb and wattles, which are reduced to a minimum, but especially in the carriage and in the strong, broad breast. The bird is heavily and closely feathered, vigorous and alert, and on the whole seems well adapted to withstand severe winter conditions. Exhibits of the breed at Montreal have shown a large percentage conforming to the "Standard," and the flock as seen at La Trappe exhibits greater conformity than might be expected after so few years of selection. It can scarcely yet be considered as fixed in type; it will require the continued efforts of Brother Wilfrid and other admirers of the breed to get its characters as well established as they are in some of the older existing breeds.

Incidentally, it should be mentioned that the "Chantecler" is not the only production for which the monastery is famous in the Province. It has in addition a considerable reputation for its Oka wine, Oka cheese and a special selection of muskmelon, the Oka melon, which is especially served by one of the exclusive hotels of Montreal.

Following is the standard for the "Chantecler" as adopted by the "Association des Eleveurs de la Poule Canadienne 'Chantecler:' "

MALE

Head: Short, large skull, indicating a strong constitution.

Beak: Stout, slightly curved.

Eyes: Medium size, almost round, with a bright expression.

Comb: Cushion-shaped, rather small, set firm on the fore part of the head; the front and rear square and not with any point, level surface, smooth and not covered with small round points.

Wattles and Ear-lobes: Rather small, of a smooth texture. Ear-lobes oval shape, wattle almost round.

Neck: Medium length, slightly arched, becoming smaller near the head; hackle abounding, flowing well over shoulders with no apparent break of cape.

Wings: Well folded, the points of flights well covered by saddle feathers.

Back: Long, broad in its entire length; slightly curving at bottom of tail. Saddle feathers abundant.

Tail: Of medium length, carried at an angle of 45 degrees above the horizontal. Sickles of medium length, slightly extending beyond the main tail feathers which can be seen through.

Breast: Large, deep, well rounded, prominent.

Fluff: Short and full.

Body: Long, large. (Feathers closely set to body.)

Legs and Toes: Thighs of medium length, large, well covered with soft feathers. Toes straight, four in number for each leg.

FEMALE

Head: Short, small, with large skull, same as rooster.

Beak: Stout, strong, slightly curved.

Eyes: Medium size, almost round.

Comb: Cushion-shaped, very small, level surface, smooth and not covered with small rounded points, square at the front and rear.

Wattles and Ear-Lobes: Very small, scarcely perceptible.

Neck: Medium length, arched, becoming smaller near the head.

Wings: Well folded and of medium length.

Back: Long, broad at shoulders, slightly sloping near the saddle and slightly curving near the tail.

Tail: Medium length, carried at an angle of 45 degrees above the horizontal.

Breast: Large, full, well rounded, prominent.

Body: Long, large. (Feathers closely set to body.)

Fluff: Short and full.

Legs and Toes: Thighs of medium length, well covered with soft feathers, shanks of medium length, bare and well set apart. Toes, straight, of medium length.

COLOR IN BOTH SEXES

Beak: Yellow.
Eyes: Reddish bay.
Comb, Face, Wattles and Ear-lobes: Bright red.
Plumage: Snow white.
Shanks: Yellow.

DISQUALIFICATIONS

Specimens having any of the following defects are subject to disqualification:

White in ear-lobes.

One or more feathers foreign to the breed.

Comb that is not cushion-shaped.

Legs any other colour than yellow.

One or more feathers or unmistakable indication of feathers on shanks and toes.

Wry tail and any other deformity inherent to other breeds.

STANDARD WEIGHT

	lbs.		lbs.
Cock	9	Hen	7
Cockerel	8	Pullet	6½

Social Hygiene

THE LAWS OF SEX, by Edith Houghton Hooker. Pp. 373. Rational Sex Series, Boston, Richard G. Badger, 1921.

To the genetist, the title of this book is something of a misnomer, as it deals principally with prostitution and the venereal diseases—distinct problems which the author does not always differentiate carefully enough. The tone is that of the so-called feminists, with its underlying accompaniment of sex-antagonism. The volume should have been edited by some one who would have removed at least the more glaring of the numerous inaccuracies and loose statements, e.g. (p. 102) "It has now been discovered that one additional chromosome receptor comes from the female parent which may presuppose an accentuated maternal inheritance." And why should remarks like these (p. 197) be printed: "Syphilis is the only disease known to humanity as being definitely hereditary. . . . Later researches indicate that a syphilitic child has probably never been born of a non-syphilitic mother, for through the placenta the spirochetes have ready access to the maternal circulation." Why not simply say that syphilis is *not* hereditary, but is transmitted to a child *in utero* by an infected mother? Again, what confidence can be placed in an author who seriously asserts (p. 90) that in the United States "Only one child out of five lives even until his first birthday," and (p. 89) "In America, where the transmission of knowledge of birth-control methods has been made a felony, of all the children born only one child out of fifteen lives to reach his twenty-first year." The first life expectancy table to which I turn tells me that of 100,000 children born in a given period, 88,538 will be alive at the beginning of the second year, and 81,506 at the end of the 14th. This is doubtless not exact, but compared with Mrs. Hooker's figures it is micrometric accuracy. The author presents a detailed program for solving what she is pleased to call "the social evil"; the single standard of morality is the foundation of her recommendations, many of which are good.—P.P.

LOUIS TRABUT, BOTANIST AND PLANT BREEDER

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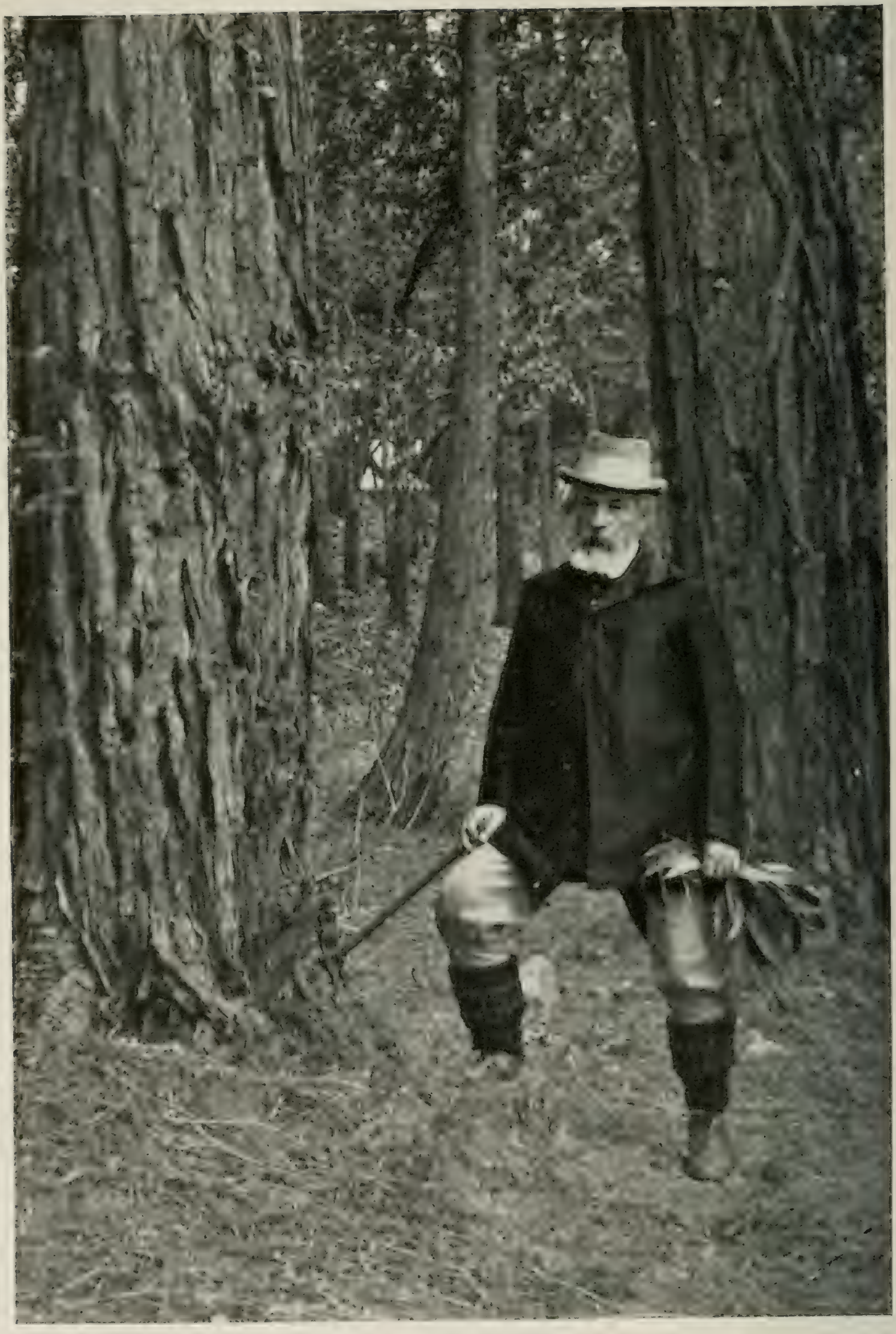
A FIELD OF SISAL AT ROUIBA ALGERIA

Figure 3. Sisal (*Agave Sisalana*), is grown on a large scale in Yucatan and furnishes the fiber from which binder twine is made. In the endeavor to develop a hardy race adapted to Algerian conditions, Dr. Trabut has hybridized Sisal with other species of Agave. Photograph by C. S. Scofield.

THE second award of the Frank Meyer Memorial Medal for distinguished service in Plant Introduction was made to Dr. Louis Trabut, Government Botanist of Algeria. This award by the Council of the American Genetic Association was in recognition not only of the inestimable value to his own country of Dr. Trabut's work in plant introduction and plant breeding, but of his very substantial contributions to agriculture in the United States, for with his co-operation many promising varieties of field crops, fruit trees and ornamentals have been introduced into this country. Not the least of his services has been the very effectual aid rendered to numerous agents of the U. S. Department of Agriculture who have visted the French North African colonies in the interest of plant introduction. These men cherish the recollection of Trabut's unfailing courtesy, of his readiness to facilitate their researches and of his generosity in sharing with them his profound and varied knowledge of the native flora and cultivated plants of that most interesting region.

EARLY BOTANICAL ACTIVITIES

Louis Trabut was born in 1853 at Chambéry in the beautiful mountain district of southeastern France. During his period of military service he was stationed in Algeria and found the country so much to his liking that after leaving the army he took up his residence in the colony which he has served so devotedly ever since. During the early years of his residence in Algeria he practiced medicine and has long held the professorship of botany in the School of Medicine of the



LOUIS TRABUT

FIGURE 4. Although born in France, Dr. Trabut has spent the greater part of his life in her North African colony with which he became acquainted while in military service. During the early years of his residence there he practiced medicine, and has long held the professorship of medical botany at the University of Algiers. Largely through Dr. Trabut's efforts, the colonial government was convinced of the necessity of establishing an agricultural experiment station. In 1894 he was given charge of the new work, and has held the position of director ever since. The large trees call attention to the great variation of climate and other natural conditions in Algeria which we are accustomed to think of as a largely desert region.

University of Algiers. His training both in medicine and in botany led him to discover the therapeutic value of certain native plants, notably the Atlas Cedar, a tree closely allied to the famous Cedar of Lebanon.

With his colleague, Dr. Battandier, Trabut devoted many years to botanical investigations which resulted in the publication of the authoritative Flora of Algeria, by Battandier and Trabut. In the course of these researches every part of the colony was traversed, largely on foot, and as a result Trabut acquired an intimacy of knowledge of the wild and cultivated plants which bore golden fruit when his plant breeding activities began.

Algeria, which faces France on the southern shore of the Mediterranean, was once a Roman colony and was in a high state of development at the beginning of the Christian era. Northern Africa was long the granary of the Roman Empire and was renowned also for its extensive vineyards and orchards. Traces of the advanced state of agriculture at that epoch are still to be seen in the numerous ruins of irrigation works and of mills for extracting olive oil. The Arab invasion swept away this ancient culture and much of the country was turned into a desert. In this condition it remained until the French occupation began, less than a century ago.

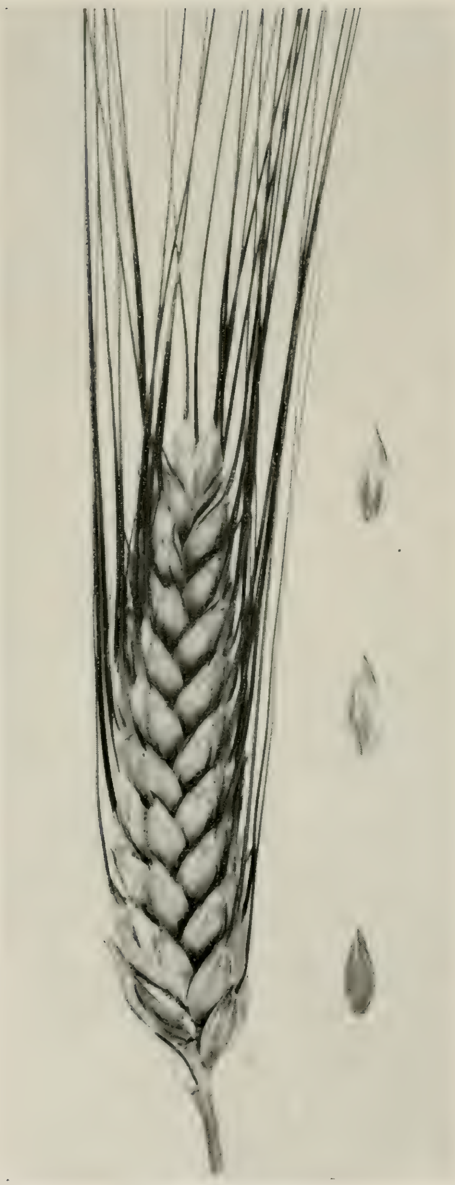
For more than a thousand years agriculture and horticulture were carried on almost exclusively by the Berbers, relics of the indigenous population who had sought refuge in remote mountain districts; the Arabs, essentially a nomadic and pastoral people, preferring to inhabit the plains and lowlands. The isolation and inaccessibility of the Berber communities were peculiarly favorable to the development and propagation of numerous varieties of cultivated plants. The result is seen to-day in the myriad races of the grape, fig, olive, apricot, and walnut grown in Morocco, Algeria, and Tunis. Every little group of mountains, one might almost say every mountain village, has its peculiar varieties. In addition to the varieties now in cultivation, numbers exist in a half-wild state which are doubtless relics of ancient cultivation. There are also in northern Africa truly indigenous relatives of many of the cultivated plants. The country is therefore a storehouse of species and varieties whose utilization as resistant stocks whereon to graft more tender forms, or as material for improvement by selection and hybridization, offers a wonderful opportunity to the plant introducer and plant breeder.

ESTABLISHMENT OF EXPERIMENT STATIONS IN ALGERIA

These things did not escape the keen eye of Dr. Trabut as he pursued his botanical investigations throughout the colony. There came to him the idea of an experiment station where the cultivated varieties and related wild forms could be brought together for comparative study. The colonial government was finally convinced of the merit of this project and the Botanical Service of Algeria was created with Dr. Trabut as Director, a position which he still holds.

The much desired botanical station was established at Rouïba in 1894 and was later removed to Maison Carrée, a suburb of Algiers.[1] Little by little the activities of the Service expanded and are now fourfold, embracing plant introduction, studies of plant diseases and administration of the plant quarantine regulations in addition to the original botanical and horticultural investigations. The parent station at Rouïba has been retained for viticultural investigations, a farm of 250 acres in western Algeria has been acquired for the study of irrigation agriculture and of alkali soils, and a Saharan station has been created for the investigation of date culture.

[1] A summary of the work in plant introduction and plant breeding at Rouïba and at Maison Carrée is given by L. Trabut and R. Maire in the *Revue de Botanique Appliquée et d'Agriculture Coloniale,* II:86–92. 1922.



PÉLISSIER WHEAT

FIGURE 5. Pélissier, a black-bearded wheat of the hard or *durum* type extensively grown in northern Africa. This variety originated with a selection made by Dr. Trabut among the numerous races cultivated by the natives of Algeria. It is now grown considerably in Montana and has been found especially satisfactory in the manufacture of macaroni and semolina. Photograph from the Office of Cereal Investigation. (See text on this page.)

BOTANICAL KNOWLEDGE APPLIED IN BREEDING PLANTS

In an address before the Botanical Society of France, meeting in Tunisia in 1909, Dr. Trabut emphasized the importance of systematic botany as the basis of all progress in applied botany. Never has this truth been better illustrated than in his own career. Trabut's acute and profound knowledge of systematic botany has given him an exceptionally solid foundation upon which to base his work as plant breeder and plant introducer, as will be shown by a few examples.

A systematic study of the numerous races of wheat grown by the natives, several of which often are found in the same field, resulted in the segregation of the Pélissier variety, a black bearded wheat of the *durum* type, now extensively cultivated in Algeria. Locally grown varieties of oats, highly resistant to rust, have been discovered and popularized. Incidentally, evidence was obtained that the Algerian oats are derived from *Avena sterilis*, a botanical species distinct from that to which the European varieties have been traced (*A. fatua*).[2] The forage value of numerous grasses, Leguminosae, and other native plants has been determined and the best of these have been introduced into cultivation.

Still more striking, perhaps, have been the results attained with orchard crops. Botanical investigation of the species of Pyrus, the genus to which the cultivated pear belongs, led to the description of several new species, one of which, *P. gharbiana* Trabut, has proved valuable as a stock for the pear when grown on limestone soils. Native varieties of the Persian walnut have been found which flourish in Algeria on their own roots, as is not the case with the varieties introduced from France. The numerous Algerian varieties of the grape have been investigated and selection has been made of those which seem most promising. One of of these, popularized by Trabut and known to the French colonists as

[2] See JOURNAL OF HEREDITY, V:74–85. 1914.

ONE OF DR. TRABUT'S MOST IMPORTANT CONTRIBUTIONS TO AMERICAN HORTICULTURE

FIGURE 6. Athel or Evergreen Tamarisk (*Tamarix articulata*) at Indio, California, showing the growth made in 18 months after the cuttings were planted. This interesting and beautiful native of the Sahara, contributed to American horticulture by Dr. Trabut, is proving to be an ideal plant for wind-breaks in the deserts of southeastern California. The absence of surface roots is a valuable feature, as it makes it possible to grow other plants close to the rows of Athel. Photograph by Peter Bisset. (See text, p. 160.)

"Clairette égreneuse," is now one of the leading white wine grapes of the colony. Studies have been made of the native varieties of the fig, olive, and apricot and the best have been selected for general cultivation. Similar investigation of the numerous varieties of the date palm occurring in the oases of the Sahara has been begun recently at the new desert station south of Biskra.

These investigations led to the interesting discovery that in varieties of fruit trees which are habitually seed-propagated by the Kabyle mountaineers, the seedlings are much truer to type than is the case with the standard vegetatively propagated varieties.

PLANT INTRODUCTION ACTIVITIES

Not content with collecting and studying the cultivated plants already existing in the colony, Trabut has been tireless in his efforts to introduce from foreign countries, plants which might contribute to the improvement of existing plant industries or form the basis of new ones. Some of his most important achievements in this field have been the introduction and dissemination of the pecan, the kumquat, and Japanese varieties of the plum. The Washington navel orange is one of his recent introductions. Efforts to popularize the grapefruit

AN ARAB VILLAGE

FIGURE 7. An oasis near the northern edge of the Sahara, showing a characteristic mud-brick village closely encircled by its gardens of date palms. The new station for the study and breeding of the date, under Dr. Trabut's direction, is situated in this region. Comparison with Figure 4 gives some idea of the diversity of natural conditions in Algeria, as a result of which the opportunities for horticultural and plant breeding work, are almost illimitable. (See text, p. 156.)

and the avocado in Algeria have thus far been unsuccessful. The colony is indebted to Trabut for a host of exotic ornamental plants and of shade and forest trees, one of the finest of the latter being the handsome Canary Island pine.

Bersim or Alexandrian clover, the most valuable forage plant of the Nile Delta, has been acclimatized after years of effort through the discovery and segregation of a strain resistant to low temperatures. With a view to fostering the cultivation of cotton and tobacco in Algeria, collections of the leading varieties of these crops have been assembled and progress is being made in the development by selection and hybridization of races adapted to the local conditions.

Trabut has discovered several natural hybrids between different species of Eucalyptus, a tree which is extensively grown in Algeria. One of these, named in his honor *Eucalyptus Trabuti*, gives a wood suitable for cabinetmaking and said to resemble mahogany. Another hybrid, *E. algeriensis* Trabut, he has found to be self-sown, which is not the case with other members of the genus in Algeria. Superior and more productive races of the camphor tree and of the soapberry tree have been developed by selection.

CREATION OF NEW HYBRIDS

Hybridization work of the greatest importance has been carried on at the botanical stations of Rouïba and Maison Carrée with cereals, cotton, tobacco, the artichoke, sisal and related species of Agave, Opuntia or prickly pear, citrus, grapes, loquats and many other groups of plants. This phase of Trabut's work not only has enriched agriculture and horticulture with valuable new forms but has led to a conclusion of great scientific interest, that many of the important cultivated plants have originated as hybrids between two or more botanical species. Evidence of this has been presented in the cases of alfalfa and the fig.

CONTRIBUTIONS TO AMERICAN AGRICULTURE

There is no little resemblance in climate and in the native and cultivated vegetation between Algeria and the southwestern United States. The Mediterranean littoral, with its chaparral-clad hillsides and its mountain forests of live-oak and pine, finds its counterpart in the coast region of California. The interior plateau, covered largely with coarse bunch grass, resembles the high plains of New Mexico, and the vast Sahara is reproduced on a smaller scale in the deserts of southeastern California. This similarity of conditions has made the North African colony a Mecca of agricultural explorers in search of plants for introduction into the southwestern United States. Cooperative relations with Dr. Trabut were established more than twenty years ago by Walter T. Swingle and David Fairchild of the Bureau of Plant Industry, and as a result hundreds of Algerian plants have been brought to this country.

Numerous but unsuccessful efforts had been made to produce the fine Smyrna fig in California, the reason for the earlier failures having been the absence of the tiny insect (Blastophaga) which caprifies or pollinates the female flowers. With the aid of Dr. Trabut, Blastophaga finally was introduced successfully by Mr. Swingle and Smyrna fig production is now a thriving industry in California. Trabut has also co-operated enthusiastically in the introduction of numerous varieties of dates from the North African deserts and has the credit of inventing an effective method of maturing the fruit on the tree by enclosing the clusters in paper bags.

Pélissier wheat, one of Trabut's selections, ranks among the best of the hard wheats tested in Montana by the Office of Cereal Investigations of the Bureau of Plant Industry and has reached the stage of commercial production in that state. It appears to be especially suitable for the manufacture

of macaroni and semolina. The Tangier pea, a relative of the sweet pea native in northern Africa and received through Dr. Trabut, is reported, by Professor C. V. Piper, as giving wonderfully heavy yields on the Pacific Coast, and if means can be found to improve its seed production it bids fair to become an important forage plant in that part of the United States.

Not the least interesting of the plants received from Dr. Trabut is the Athel or Evergreen Tamarisk, a tree native in the Sahara Desert. This plant was introduced with the co-operation of Professor J. J. Thornber, Director of the Arizona State Experiment Station, who supplied material for trial at the U. S. Government Date Garden at Indio, Calif. To Mr. Bruce Drummond, Superintendent of the Date Garden, belongs the credit of having recognized that the Athel is peculiarly suitable for the creation of windbreaks in the Colorado Desert region, because of its wonderfully rapid growth. Eighteen months after the cuttings were planted the trees had reached a height of 20 feet and when 5 years old some of them were 50 feet high and from 14 to 19 inches in diameter at the base of the trunk. An ideal plant for the protection of orchards, fields and homes against the sand-laden winds of the southwestern deserts had been found at last. So prompt was the recognition of this fact that within 5 years after the first planting of the Athel at Indio it was estimated that 25,000 cuttings had been set out in that vicinity. Rapid growth is by no means the only merit of this tamarisk, for it is highly ornamental and the wood not only supplies excellent fuel, but is said to be of value for construction purposes. Had Trabut made no other contribution to American agriculture, our debt to him for this would be no small one.

Great as is the value, actual or potential, of the plants introduced or bred by Dr. Trabut, the inspiration of his career is after all his greatest gift to humanity. He has set a priceless example in devoting his brilliant, highly-trained, well-stored mind to the lifelong service of his countrymen and of all mankind.

Biology *vs.* Bolshevism

The Revolt Against Civilization: The Menace of the Underman, by Lothrop Stoddard. Pp. 274. Charles Scribner's Sons, New York, 1922.

The increasing complexity of civilization, and the production, for reasons well understood by eugenists, of a large body of inferior people in every civilized community, are the fundamental factors underlying revolution, in Dr. Stoddard's opinion. Hating a society which they realize they are unable to enter, the "Under-Men" naturally attempt to destroy it, in order to establish a state of affairs where they may feel themselves more at home. Nearly half the volume is taken up by an exposition of the basic principles of eugenics; the remainder is given over to a description of the revolutionary movement, particularly as represented by Bolshevism, Syndicalism, and the I.W.W.,—three different names, Dr. Stoddard believes, for the same thing. From this point of view, the way to avoid revolution is to adopt such eugenic measures as will decrease the production of men and women of inferior mentality. This bald synopsis cannot do justice to the vivid, at times sensational, presentation of the facts which Dr. Stoddard has written and which, it is safe to say, will lead many people to think of social problems in terms of correct biology who have never done so before. The book deserves, and will unquestionably get, wide circulation.—P. P.

BROTHERS IN RUGBY FOOTBALL

More Evidence That Brothers are Selected to Play in the Same or Similar Positions on Football Teams

H. W. Jack,
Kuala Lumpur, Federated Malay States

In connection with a brief article which appeared in Vol. XII, No. 6, (June-July 1921) of the Journal of Heredity dealing with a study which showed that brothers were often selected to fill the same or similar positions on football teams, I append herewith a list of 23 sets of brothers representing 63 players of the game of rugby football in the British Isles, most of whom achieved distinction in the game and all of whom are personally known to the writer.

That many of the players were exceptionally good men is evidenced by the fact that twelve of their number were selected to play in the British International contests and of the remainder, 22 played in the International trial (Provincial) matches, and all the rest were members of first class teams chosen by expert committees.

In British rugby football the qualities of a forward are that he must be strong, fairly heavy, and able to stand considerable strain and fatigue.

Halves or centre three-quarters are characterized by their ability to make quick decisions, to kick and tackle well and by their daring to take risks. For wing players the essentials are speed and pluck.

Of the 23 sets of brothers quoted, at least two in every case were selected to play in the same positions, while in eleven sets of three or more brothers at least three were chosen for the same positions. In one case a set of four brothers were all picked for the same or similar positions. These notes disdinctly show that the ability required for playing in certain positions in rugby football is inherited and runs in families.

The following list includes all the pairs of brothers which the writer can recollect, and yet in no case where sets of two only are considered were the brothers selected to play in different positions, and in only five cases was there a variation when considering sets of three or more brothers. The list covers a period of approximately ten years.

Name	*Team*	*Locality*	*Position*	*Distinction*
Ryan, M.	Rockwell	Tipperary	forward	International
" J.	"	"	"	"
Thompson, R.	Queens	Cork	"	"
" W.	"	"	"	Province
Coyne, Eng.	C. B. C.	"	centre	College
" J.	"	"	forward	"
" Ed.	"	"	"	"
Aheane, T.	"	"	"	"
" M.	"	"	"	"
" R.	"	"	"	"
Young, G.	University	"	wing	International
" W.	"	"	forward	Province
" C.	"	"	"	County
Bennett, Joe	"	"	"	Province
" Jack	"	Belfast	centre	"
" T.	Methodist College	"	forward	College
" H.	Wesley College	Dublin	"	"

Name	*Team*	*Locality*	*Position*	*Distinction*
Bateman, N.	Queens	Cork	forward	Province
" W.	"	"	"	County
" M.	"	"	"	Province
Fitzgerald, A.	C. B. C.	"	half	County
" W.	"	"	"	College
Musgrave, J.	Constitution F. C.	"	centre	Province
" A.	Grammar F. C.	"	"	College
" C.	Queens F. C.	"	"	"
Cullen, A.	Blackheath F. C.	London	half or centre	International
" W.	"	"	"	Province
Kilmartin, A.	(Presentation) (College Cork)	Cork	half	"
" J.	Constitution F. C.	"	"	County
Pillman, C.	Blackheath	London	forward	International
" A.	"	"	"	County
Duggan, W.	University	Cork	wing	International
" D.	"	"	"	County
Dennley, W.	Cork	"	forward	"
" J.	"	"	"	Province
O'Reagan, J.	"	"	centre or wing	"
" Jack	Waterford	Waterford	"	County
" T.	C. B. C.	"	"	College
" W.	"	"	"	Province
Mc. Grath, R.	Constitution	Cork	"	International
" H.	"	"	"	Province
Sheehan, T.	University	"	wing	"
" John	"	"	"	"
" Joe	Dolphin	"	"	County
Jack, E.	Queens	"	half or centre	College
" C.	University	"	"	University
" H. W.	"	"	"	International
Linehan, T.	Queens	"	forward	Province
" J.	University	"	wing	"
" W.	"	"	forward	"
" E.	C. B. C.	"	"	College
Lanktree, H.	Constitution	"	"	County
" C.	C. B. C.	"	"	College
" T.	"	"	"	"
O'Connor, G.	University	"	"	Province
" Jim	"	"	centre	"
" K.	C. B. C.	"	forward	College
" John	University	"	"	Province
Roche, P.	"	"	wing	County
" R.	Cork	"	"	Province
Smith, T.	Collegians	Belfast	forward	International
" W.	"	"	"	"
" J.	"	"	"	"

American Degeneration

Race Decadence, by William S. Sadler, M.D. Pp. 421, price \$2.50. Chicago, A. C. McClurg & Co., 1922.

In a "popular" style, Dr. Sadler gives a great volume of information about the nature and causes of the mental and physical deterioration of the American people. This book merely states the problem, so to speak, and the solution of the problem is reserved for three other volumes to follow in the same series, dealing with theoretical and applied genetics. Covering a wide range of topics, the author can not be expected to deal with all of them in an equally satisfactory way, but he has succeeded to a rather remarkable degree in making a fair and accurate presentation of his case, in terms understandable by any newspaper reader. The diagnosis of the physical and mental infirmities of the nation is accompanied by a good deal of common-sense advice as to hygiene and treatment.—P.P.

AN HISTORIC ORANGE TREE

BEVERLY T. GALLOWAY
U. S. Department of Agriculture, Washington, D. C.

TREES are like folks. Some come into the world great, some achieve greatness, and some have greatness thrust upon them.

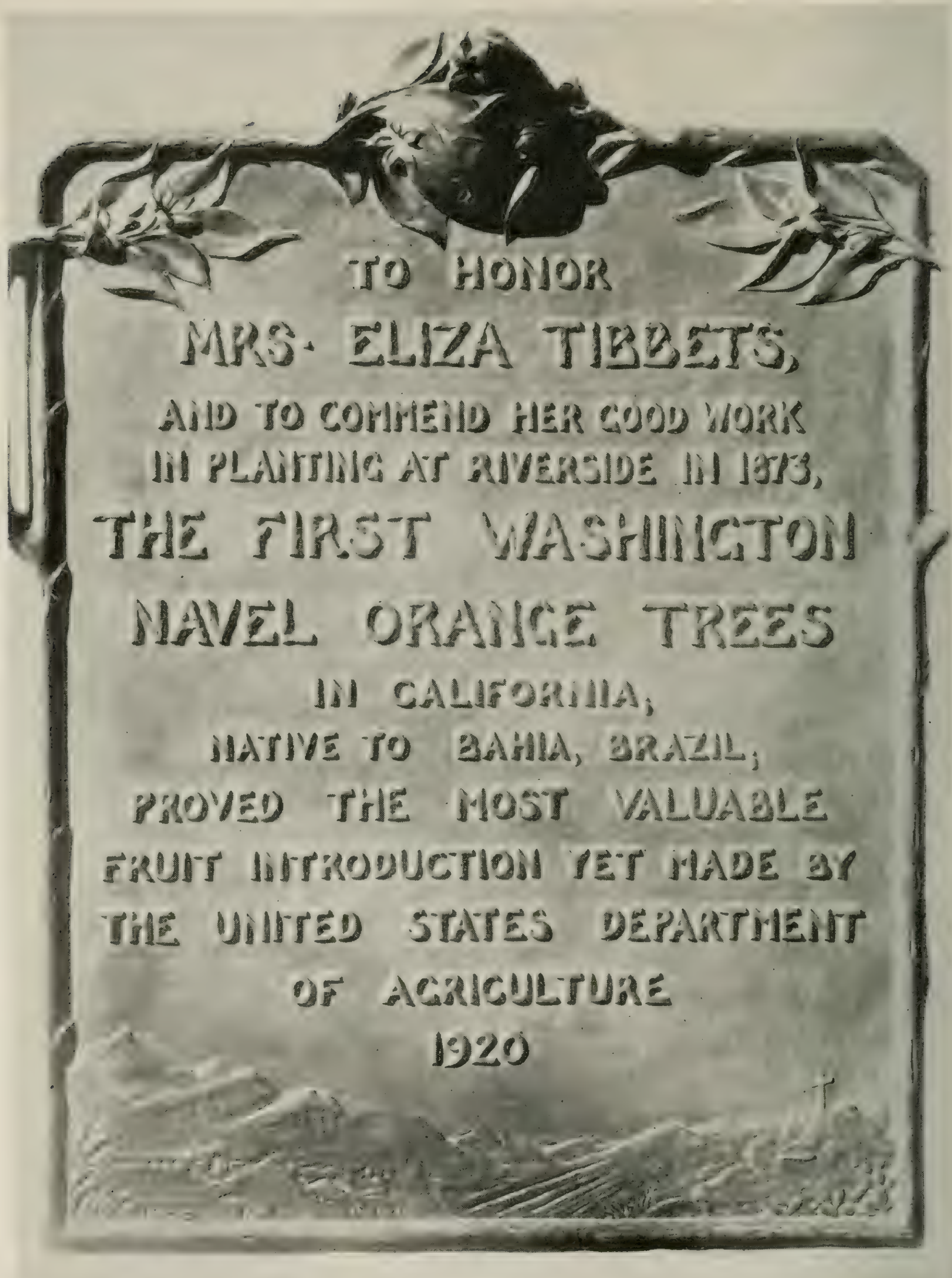
In one of the greenhouses of the U. S. Department of Agriculture at Washington is an old orange tree whose life has been an eventful one, and even now after nearly fifty years its days of romance are not over. Verily, it has achieved greatness. Surrounding the Patriarch and serving as a guard of honor, so to speak, is probably one of the most unique collections of citrus and citrus relatives to be found anywhere in the world. Dr. Walter T. Swingle has been bringing these citrus plants together for study in connection with his orange breeding and related work. The old patriarch has plenty of company and plenty of relatives, and it is altogether fitting that it should spend its last days surrounded by so many of its kindred.

The old tree is one of the two survivors, so far as known, of the earliest propagated stock from ten or twelve small plants of the navel orange introduced from Bahia, Brazil, by the late William Saunders, for many years Superintendent of the Gardens and Grounds, U. S. Department of Agriculture. The other tree is located at Riverside, California. It was about the year 1867 that Mr. Saunders constructed an orange house on the Department grounds, near where the large marble building occupied by the Bureau of Plant Industry now stands. He began assembling oranges from different parts of the world and many of them were planted and fruited out in this house. Thus, as early as 1871, Mr. Saunders, in his report to the Commissioner of Agriculture, stated that efforts had been made to secure complete collections of citrus. He further stated that the collection numbered about fifty kinds, but that propagation and distribution had been confined almost solely to the Maltese Oval, the true Saint Michael, and the Tangerine. In none of the published official reports made by Mr. Saunders to the Commissioner of Agriculture does he mention the navel orange so that documentary records of its introduction, propagation, and distribution are lacking.

We have known the tree growing in the Department greenhouse for thirty-five years, and it is not much larger now than when we first saw it in the old orange house in 1887. For many years it was our understanding that this tree was one of the original ten or twelve that were shipped to Mr. Saunders from Bahia, Brazil, about 1870. Dr. William A. Taylor, Chief of the Bureau of Plant Industry, is authority for the statement that Mr. Saunders told him in 1891 that the tree was budded from one of the original introductions. What became of the ten or twelve imported trees is not definitely known. Mr. Saunders in his notes made in 1898 or later, published by Dorsett, Shamel, and Popenoe[1] in 1917, says that all were fruited in Washington. Presumably all of the original trees were held in Washington for a considerable time, for Mr. Saunders in speaking of their arrival says that he had a supply of young stocks on hand and that as fast as he could secure buds they were worked on the stocks.

The first two young plants sent out, according to Mr. Saunders, were forwarded to Mrs. Eliza Tibbets of Riverside, California. These trees have become historic, and only recently a

[1] *U. S. Department of Agriculture Bulletin*, No. 445. 1917.



BRONZE TABLET IN HONOR OF THE PLANTER OF THE FIRST NAVAL ORANGE TREES IN CALIFORNIA

FIGURE 8. It is not known what happened to the original naval orange trees imported from Brazil. There were about a dozen of these, but Mr. Saunders made it plain that the plants he sent to Mrs. Tibbets were budded from the Brazilian trees and were not the original introductions. For the past five years the family of these unheralded plant emigrants has yielded an average crop of 8,400,000 boxes of oranges.

NAVEL ORANGE TREE FROM BAHIA, BRAZIL

FIGURE 9. One of the earliest propagated from the original introduction made by the late William Saunders of the U. S. Department of Agriculture in 1870. This tree, growing in the Department of Agriculture greenhouse, is about fifty years old and is one of the two sole survivors of the old stock. The remaining tree is growing at Riverside, California. Photograph by E. L. Crandall. (See text p. 163.)

tablet was unveiled at Riverside honoring Mrs. Tibbets for the part she took in the pioneer work of establishing one of the great fruit industries of the country. Only one of the original Riverside trees is living and it is not very vigorous. Despite the vicissitudes through which the old tree in the Department greenhouse has passed, it is still lusty. Planted first in the ground of the original orange house, it remained peacefully at home there until 1903, when it became necessary to demolish the orange house in order to construct new buildings for the Department of Agriculture. The old tree was carefully lifted and planted in a tub. We had a large palm house and the tubbed tree was kept there for a time. Later it became necessary to dismantle the palm house and the old tree was sent to the Washington Botanical Gardens located near the Capitol grounds. There it remained until about nine years ago, when it was brought back and planted in the ground in a new house constructed for tropical and subtropical fruits, but now devoted exclusively to citrus. We do not know the exact age of this tree, nor when it was first planted in the original orange house. Neither do we know whether it is older or younger than the tree at Riverside. Presumably the two trees are of about the same age, namely, fifty years. Their greatest monument is found in California where their family has increased until it now numbers nearly nine million trees, yielding an annual crop of fruit which for the past five years has averaged 8,400,000 boxes, with a maximum crop of 13,000,000 boxes.

Talks to Mothers

The needlessly high maternal and infant death rate in the United States should not simply be deplored, but should be remedied. Combating and correcting this condition has been the function of the Maternity Center Association during its years of existence. The recent publication of a series of twelve *Talks to Mothers* is another commendable effort toward their goal.

The *Talks* are expressive of the aim of the organization. According to Miss Nancy E. Cadmus, R. N., general director of the Maternity Center Association, the Association's purpose is "not to try to supplant the doctor or nurse. The expectant mother is urged at every opportunity to place herself under expert professional medical and nursing care." The burden of their message is proper and adequate medical care for mothers and babies. These helpful and instructive pamphlets may be obtained for the nominal sum of 25c from the Maternity Center Association, 370 Seventh Avenue, New York City.

Biological Facts Underlie Social Questions

"A better knowledge of the accepted laws of heredity, together with a more complete understanding of the comparative value and influence of race and education—of nature and nurture—would greatly assist us in solving some of our social questions, while at the same time we would be helped in our future planning for the betterment of the citizenry of coming generations. The time has come to requisition science and draft scientists to help us in the great battle for social regeneration and racial advancement."

"The hour has come when the facts of organic evolution and the biologic teachings of modern eugenics should be applied to the great problems of the national administration as relates to immigration, labor and capital, sanitation, social reforms, the colored race problem, poverty, and the other great questions of national uplift and race betterment."—W. S. Sadler, M.D.

THE EFFECT OF THE AGE OF SIRE AND DAM ON THE QUALITY OF OFFSPRING IN DAIRY COWS

C. L. Allen
Cornell University, Ithaca, N. Y.

A FAMOUS HOLSTEIN SIRE

Figure 10. Ormsby Korndyke Lad (102469) one of the great sires of the Holstein Friesian Breed. His daughters are noted for their high production records for both 7 day and yearly work. He has 18 daughters with records of over 30 pounds of butter (80% fat) in 7 days. He also has 14 daughters with records of over 1000 pounds of butter (80% fat) in one year. The sire of Ormsby Korndyke Lad was only 23 months of age when he was born and his dam was just a little over 4 years of age (51 months). Photograph from Holstein Friesian World.

The effect of the age of parents on the quality of the offspring is in a large measure concerned with the idea of cumulative inheritance, particularly if we do not consider the matter of the proven sire or dam. If an animal is a more valuable parent after it has attained maturity, it is more valuable for one of two reasons. Either the mature animal must be able, merely because of its full physical development better to impress its characters on its offspring, or the mature animal must in the process of attaining maturity, have become endowed with something, due to training or environment, which it can transmit to its progeny. After a century of study, this matter is far from settled and the question as to the possible effect of environment on the transmission of a tendency to increase or decrease certain quantitative functions is still important.

JOHANNA DE KOL CONCORDIA

FIGURE 11. At three and a half years of age her record was 19037 pounds of milk and 671 pounds of butterfat. Her sire, Sir Clothilde Concordia, was two years nine months of age when she was born, while her dam, Cold Spring Johanna De Kol 2nd, was three years and a half old. The great number of cases where the parents of high producing cows are as young, or younger than these, leaves no doubt that the off-spring of immature parents are just as good producers or transmitters of production as those born when the same parents are mature. Photo by U. S. Department of Agriculture. (See text, p. 173.)

In practical breeding, it would be very advantageous to know definitely whether the young born of immature parents are as valuable for production, and for reproducing their kind, as those born of more mature parents. It is the aim of this paper to show whether the parentage of a group of high producing or superior cows averages older than the parentage of a group of comparatively low producing or inferior cows. The paper also attempts to show the percentage distribution of offspring for the various ages of both sire and dam; the age when cows actually make their best records; and whether the offspring of very young or very old animals are inferior.

METHOD

The data reported in this paper were taken from Volume 27 of the Advanced Registry Year book and the Herd Books of the Holstein Friesian Association of America.

The superior class of animals chosen include those that up to April 30th, 1916, had made records of 24 pounds or more of butterfat in seven days. This included all of the so-called thirty pound cows since 24 pounds of butterfat is equal to 30 pounds of eighty percent butter. For purposes of more careful study, this class was divided into three groups as follows:

Group I—All cows producing over 27.3 pounds of butterfat in 7 days.

Group II—All cows producing between 25.6 and 27.3 pounds of butterfat in 7 days.

Group III—All cows producing between 24.0 and 25.6 pounds of butterfat in 7 days.

The comparatively inferior class of animals chosen includes all of the so-called mature cows, that is, cows five years of age or over, that produced less than fourteen pounds of butterfat in seven days and were entered in the 27th Volume of the Holstein Friesian Advanced Registry Year Book as entries or re-entries. This class was divided into three groups that were fairly comparable in numbers to the groups of the superior class, as follows:

Group I—All cows producing between 12 and 12.5 pounds of butterfat in 7 days.

Group II—All cows producing between 12.5 and 13.0 pounds of butterfat in 7 days.

Group III—All cows producing between 13.0 and 14.0 pounds of butterfat in 7 days.

The groups were arranged so that the very highest producers were in group 1 of the Superior Class and the very lowest producers were in group 1 of the Inferior Class. Then, if there was any difference in age, it was thought that the first groups should be further apart than the second and third groups.

The 7 day record was chosen as the basis for this study because a larger number of records were available and the 7 day record is generally recognized as a valuable method of determining the productive ability of dairy cows.

Three generation pedigrees were compiled for all the cows of both the Superior and Inferior Classes. These pedigrees included the date of birth for all animals in every pedigree. This makes it possible to compute the difference in age between any animal and its parents and tells us the age of the parents at the time the animal in question was born. This also provides data for determining the average difference in age between generations, and allows the calculation of the percentage distribution of offspring according to the age of parents, making it possible to observe whether more good cows or poor cows are born from very young or very old dams. The difference in age between parent and offspring was computed in months to the nearest month.

In order to determine at what age the superior cows made their records, it was necessary to take this data directly from the Advanced Registry Year book and record it on the pedigree.

RESULTS—THE DIFFERENCE IN AGE COMPARED

Table I gives the average age of the ancestry of the Superior and the Inferior Classes by groups and for the classes

TABLE I. *Average Age, in Months, of Ancestry of Superior and of Inferior Classes of Cows*

Ancestor	Superior Cows				Inferior Cows			
	Group 1	Group 2	Group 3	Class	Group 1	Group 2	Group 3	Class
Sire	44.3	51.7	46.3	47.1 ± .647	45.7	44.6	41.6	43.1 ± .529
Dam	62.8	63.6	61.2	61.9 ± .890	60.0	62.2	64.7	63.1 ± .941
Paternal grand sire	48.6	49.6	49.6	49.5 ± .717	45.4	46.4	46.7	46.6 ± .646
Paternal grand dam	64.9	65.2	67.6	66.7 ± .929	66.5	69.4	65.8	66.7 ± 1.034
Maternal grand sire	42.3	41.4	42.3	42.1 ± .507	44.8	43.0	43.4	43.6 ± .508
Maternal grand dam	65.2	63.0	59.6	61.0 ± .873	65.0	69.4	62.8	64.7 ± 1.013
Great grand sire[1]	44.3	44.8	48.1	46.9 ± .640	45.4	47.9	43.8	45.1 ± .602
Great grand dam[1]	61.3	59.0	63.8	62.5 ± .939	61.7	72.1	64.7	65.7 ± 1.006
Number of pedigrees in each group and class	86	121	404	611	111	114	285	510

[1] Great grand sire refers to sire of paternal grand sire. Great grand dam refers to the dam of the maternal grand dam.

as a whole. This table allows us to make comparisons and determine any significant difference between the average age of the superior cows and the (comparatively) inferior cows.

It will be noted in table I that the greatest difference in age is four months and that this occurs in the case of the sires. This difference might seem to be somewhat significant in the light of the probable error as a measure of its probable significance. The difference is more than three times the probable error but the probable error in this case is small. We must remember, however, that four months is not a very marked difference and this difference loses a large part of its significance when we study the group averages. There is more difference between the groups within the classes even here than there is between the classes themselves. This is still more noticeable in other places in the table where the class difference is not so great. Take for example, the case of the dams, the great granddams, or the maternal grand sire. In each of these cases, the difference is probably insignificant in the light of the probable error, and in each case, the difference between the groups within the class is greater than the difference between the classes.

The real difference in age between the various parents and generations is more clearly shown by means of a pedigree. Such a pedigree is given in Figure 12.

It is evident that there can be no increased hereditary value due to the age of the dams, for in every case except one, the dams of the Inferior Class average older, though not significantly so, than the dams of the Superior Class. In the one case, that of the paternal granddam, they average exactly alike.

From a study of Table I and the pedigree, Figure 12, it is apparent that there is no significant difference between the ages of parents of the Inferior and of the Superior Classes. In only one case is the difference outside the limits defined by three times the probable error. In this case, the small difference between the class averages can hardly be considered significant when there is so great a difference between the group averages within the class.

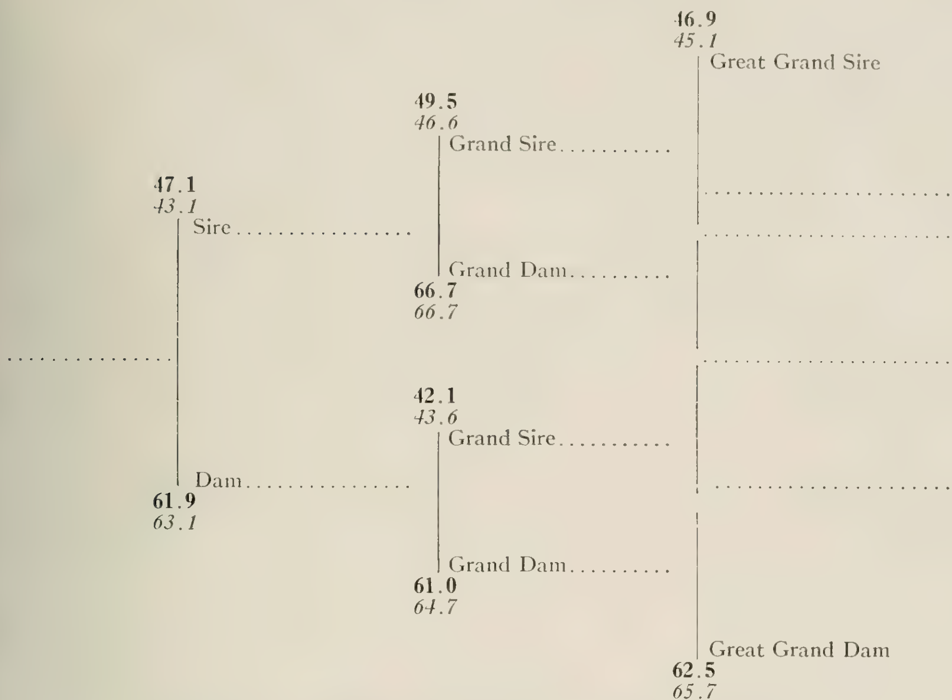
BULLS ARE NO MORE VALUABLE PARENTS AS THEY GROW OLD

Turning our attention again to the pedigree, Figure 12, we note that in every case the Superior sires on the top line of the pedigree are older than the corresponding inferior sires. The difference is probably not significant even in the case of the sires, but the tendency persists.

This led to a study to determine whether a bull produced superior offspring as he grew older. From a study of four bulls having a total of five hundred and six daughters, it seems that bulls may or may not have better daughters as they grow older, depending on the quality of animals to which they are bred. As a bull proves his superior worth, he is very likely to be bred to better cows and produce better offspring. This probably accounts for the difference shown in the pedigree. This whole matter will be fully discussed in a later paper. Thus the difference in age of sires can be very readily assigned to the use of the sires and there is no indication that the sires are any better when they are old than when young and immature. In fact the frequency distribution, Figures 13 and 14, tends to show that the young parent of either sex is just as valuable as a parent when immature as it is in later life. The frequency curves include only the sires and dams of the first generation.

FREQUENCY DISTRIBUTION ACCORDING TO AGE OF SIRE

In the frequency curves, Figures 13 and 14, it will be observed that the curves run very nearly parallel throughout. The curves start high, indicating that a large percentage of cows in both the Superior and Inferior Classes are sired by very young bulls. In this connection, it will be remembered from Table I that



AN AGE-PEDIGREE OF THE TWO CLASSES OF COWS

FIGURE 12. This shows the average age of the ancestors of the superior cows (Bold-face type), and of the inferior cows (Italics). It is evident that there are no significant differences in the age of the forebears of the two classes. (See text, p. 169.)

the sires of the Superior Class average less than four years of age, 46.4 months to be exact, and that the sires of the Inferior Class average somewhat younger. The largest number of offspring were born when their sires were from two and one-half to three years of age. This means that these bulls sired a larger percentage of their offspring between twenty-two and twenty-seven months of age than at any other time.

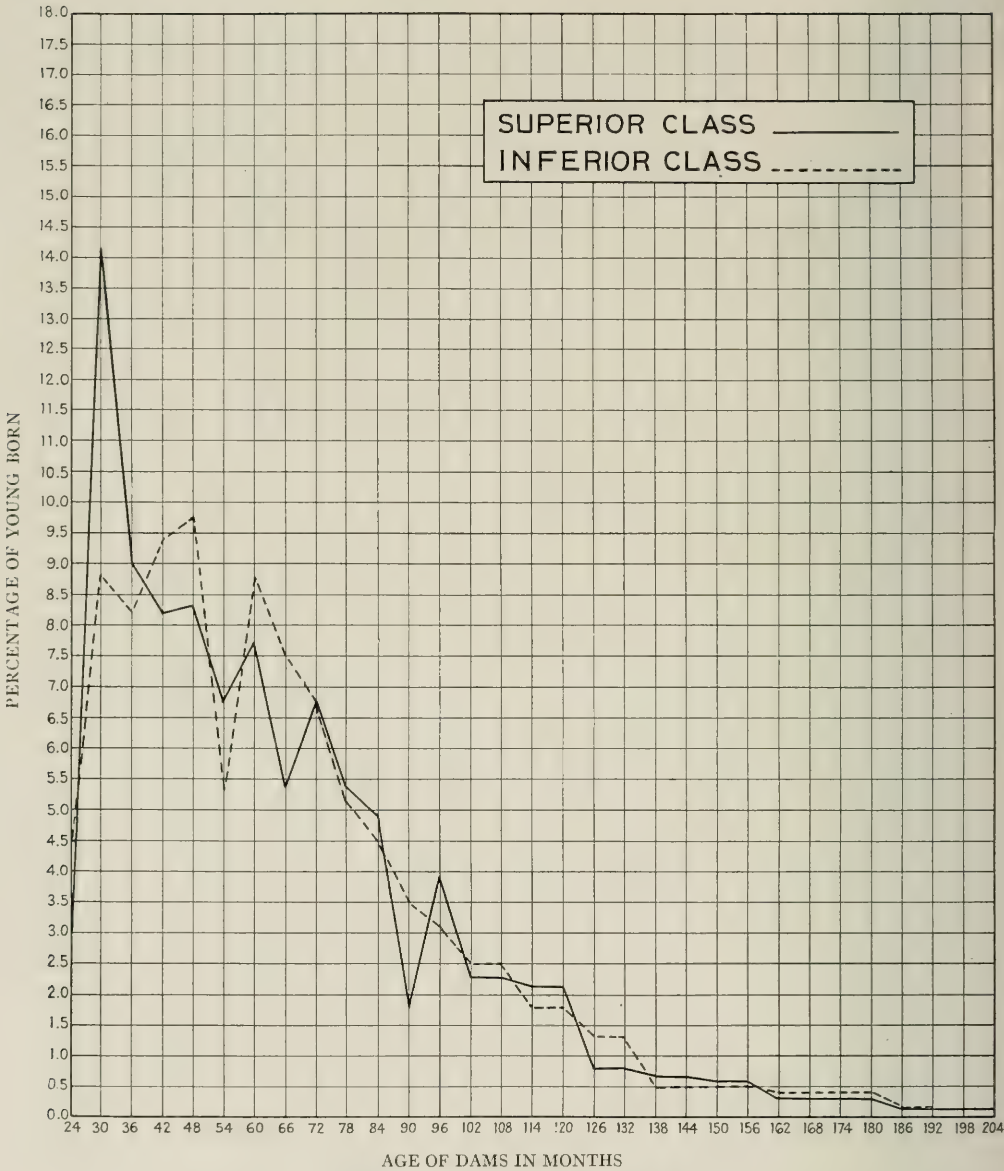
Table II shows very clearly just how our purebred sires are used. It indicates that improvement has been based on the selection of young sires rather than on the use of tried sires.

THE PROVEN SIRE

A bull cannot be called a proven sire until his first crop of heifers come in milk and can hardly be so called until these heifers have milked at least one year. Thus a bull can hardly be called a proven sire until he is five years of age. In general practice, the percentage of cows sired by unproven bulls is probably much higher than the percentage shown for the animals included in this study. This means that even the breeders who are making records use a tried sire for only a small percentage of their cows. That the tried sire is more valuable is indicated by the fact that 21.1 percent of the Superior cows are daughters of tried sires, whereas only 15.9 percent of the Inferior cows are daughters of bulls of an equal age. This may seem to conflict with the idea that the bull when old is not more valuable, but the paper referred to above shows that he is not more valuable as a parent.

FREQUENCY DISTRIBUTION ACCORDING TO AGE OF DAM

The frequency curve for the dams, Figure 13, is very much more irregular than the curve for the sires but on the

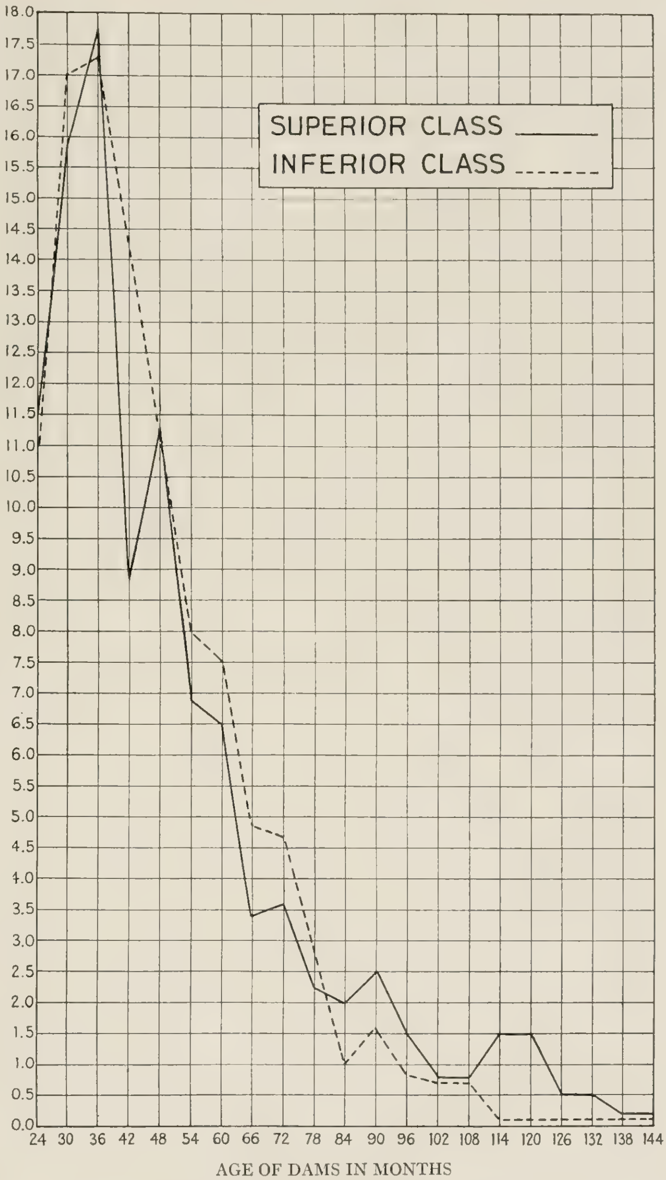


FREQUENCY CURVE FOR DAMS

FIGURE 13. The percentage of young born by dams of various ages is shown in this chart. The age of the dams is computed for six-months periods, and the upper age limit of these groups is shown. That is, all the dams 24 months and under are considered 24 months old, those between 24 and thirty months of age, as 30 months old, etc. It is evident that much the greater number of calves are born by very young cows, the quality of whose offspring cannot be known. (See text, p. 171.)

whole, even here, the curves run nearly parallel. There is, however, a distinctly larger percentage of high producers born of very young dams than there is of low producers. It is hard to account for this unless the Superior Class have received better care and are bred younger on the average than the Inferior Class.

It will be noted in connection with Table III that a slightly larger percentage of the Superior Class were born from dams under five years of age than there were of the Inferior Class. In later life, the two classes are very nearly alike and almost exactly as many of the Superior Class were born from dams over eight years of age as were born in the Inferior Class from dams of a like age. The percentage having dams over twelve years is exactly alike for both classes.



FREQUENCY CURVE FOR SIRES

FIGURE 14. The co-ordinates are the same as in the preceding chart. The same conclusions apply even more strikingly in this case, as the sires are not used for breeding purposes as long as the dams. A sire cannot be considered a proven sire until his first crop of daughters have been in milk at least a year, which means that he must be five years of age. These figures are for a selected class of sires and show that even the breeders who are making records use tried sires for only a small percentage of their cows. (See text, p. 170.)

VALUE OF OFFSPRING OF VERY YOUNG AND VERY OLD PARENTS

From a study of the frequency curves and Tables II and III, it is evident that the young born from very young parents or from very old parents are as valuable as any for productive

WATSON SEGIS PONTIAC HOMESTEAD

FIGURE 15. She was born when her dam, Watson Segis Pontiac, was just 2 years, 2 days old, when her sire, Piebe Laura Allie Homestead King, was a senior two-year-old. Her record is 25,360 pounds of milk and 928 pounds of fat. Her mother has a record of 844 pounds of fat, and she is the daughter of King Segis Pontiac Count, a great breeding sire, who was only a little over two years old when she was born. Photo by U. S. Department of Agriculture.

TABLE II. *The Percentage of Daughters Born on or before a Given Age of Sire, and the Age of the Sire at the Time the Dams of the Daughters were Bred*

Age of Sire when Daughters were born	Age of Sire when the Dams of Daughters were Bred	Percentage of Daughters	
		Superior	Inferior
30 Months and Under	21 Months and Under	27.5	28.0
36 Months and Under	27 Months and Under	45.3	45.3
60 Months and Under	51 Months and Under	78.9	84.1
Over 60 Months	Over 51 Months	21.1	15.9

TABLE III. *Showing the Percentage of Young Born Before and After a Given Age of Dam*

Age of Dam when Daughters were born	Percentage of Superior Daughters	Percentage of Inferior Daughters
30 Months and Under	17.2	13.3
36 Months and Under	26.2	21.6
60 Months and Under	57.1	54.9
Over 8 years	14.8	15.0
Over 12 Years	2.8	2.8

A SIRE OF RECORD-MAKING DAUGHTERS

FIGURE 16. King Hengeveld Aaggie Fayne (56635) has shown remarkable ability to transmit production. He was slaughtered when only three years of age and as a result has only 31 A. R. O. daughters. Eleven of these daughters have records in excess of 30 pounds of butter (80% fat) in 7 days. Four of his daughters have yearly records. Three of these records made by two and three year old heifers average 21,762.2 pounds of milk and 978.93 pounds of butterfat. The other yearly record was made by a mature daughter and is 15,486.1 pounds of milk and 530.89 pounds of butterfat.

King Hengeveld Aaggie Fayne was born when his parents were quite young. His sire was 22 months of age and his dam 28 months of age when he was born. Photo by the Holstein-Fresian World.

purposes. An unusually large percentage of the Superior Class were born before their dams were two and one-half years of age and must have been first calves. The sires of a large percentage of the Superior Class were also under two and one-half years when the dams were bred. On the other hand, just as large a percentage of the Superior Class as of the Inferior Class is from very old parents.

AGE WHEN THE BEST RECORDS ARE MADE

Table IV was arranged for the Superior Class only. The best record was used in every case. If any of the cows herein considered have made a better record since the collection of this data this fact introduces an error. It is recognized that only a very few cows have ever made more than one

TABLE IV. *The Average Age of All the Superior Cows at the Time Their Records Were Made*

	Group I	Group II	Group III	Superior Class
Number of Cows........	86	121	404	611
Average Age in Months..	69.7	72.1	73.7	72.2

record above thirty pounds of butter in a week and most of those that have done so are here considered. This error, then, is in all probability very small.

The group averages and the class average all show that the best records of the animals herein considered were made at an average age of about six years. Of course many were much older than this and many were younger, but it is well known that animals vary greatly in rapidity of development. It would seem that the numbers considered are large enough to make the average significant even though it is recognized that most cows do not have a chance to make a record every year. The cow is most likely to be tested at the time she shows greatest promise. Since these high producers made their best records at six years of age, it seems only fair to assume that they were at the height of their productive capacity at this time. It would also indicate that cows generally reach the limit of their possibilities for high production at about this age. This contention is supported from other sources,[1] although one investigator,[2] who attacked the problem in an entirely different manner, maintains that the highest production is not reached until much later in life.

SUMMARY

The parentage of superior or high producing dairy cows is no older than the parentage of comparatively inferior or low producing cows and thus the old animal is no more valuable as a parent than the young animal.

As far as the age of either parent is concerned, the young born at one time in life seem to be just as valuable as the young born at any other time.

A very large percentage of our cows are born of immature parents but the proven animal at any age is much more valuable for breeding purposes.

On the average, cows make their best records at about six years of age.

Musical Ability

THE INHERITANCE OF SPECIFIC MUSICAL CAPACITIES, by HAZEL M. STANTON, Ph.D., Eastman School of Music, Rochester, N. Y. Pp. 47. Eugenics Record Office Bulletin No. 12, Cold Spring Harbor, L.I., April, 1922. (Reprint from Psychological Monographs XXXI, No. 1, Princeton, N. J.)

Combining the family history method of investigation of the Eugenics Record Office with some of the tests for musical capacity established by C. E. Seashore of the University of Iowa, Dr. Stanton presents a picture of six family groups, each one based on a musician of some eminence. Over 500 individuals are charted, but actual tests (of the sense of pitch, sense of intensity, sense of time, and tonal memory) were given to only 85. A marked correlation was found to exist between an individual's musical ability and his or her early opportunities for hearing good music and studying it. It is assumed that the tendency of an individual with innate musical capacity to seek out such opportunities will account for this correlation. The assumption is probably correct but many persons would want proof of it. The pedigree charts, which are of course based on too few data to be conclusive, seem to indicate that the various traits are inherited, and that there is segregation in the inheritance.—P. P.

[1] PEARL RAYMOND, The Change of Milk Flow with Age. *Maine Agricultural Experiment Station Bulletin*, No. 262. 1917.

[2] GOWAN, J. W., Studies in Milk Secretion VIII. *Maine Agricultural Experiment Station Bulletin*, No. 293. 1920.

INHERITANCE IN THE SUMMER SQUASH

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and
George B. Durham
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OUR KNOWLEDGE of inheritance in *Cucurbita pepo*, that inclusive species under which are grouped the summer squashes, pumpkins, and most gourds, is not extensive. In pre-Mendelian days Naudin and others studied Cucurbita but their results are not of great value in constructing a modern genetic analysis of the group. Many of the workers on squashes have been more interested in the demarkation of species and varieties and in the possibility of making crosses between the various forms than in determining the inheritance of the particular characters displayed by the plants.

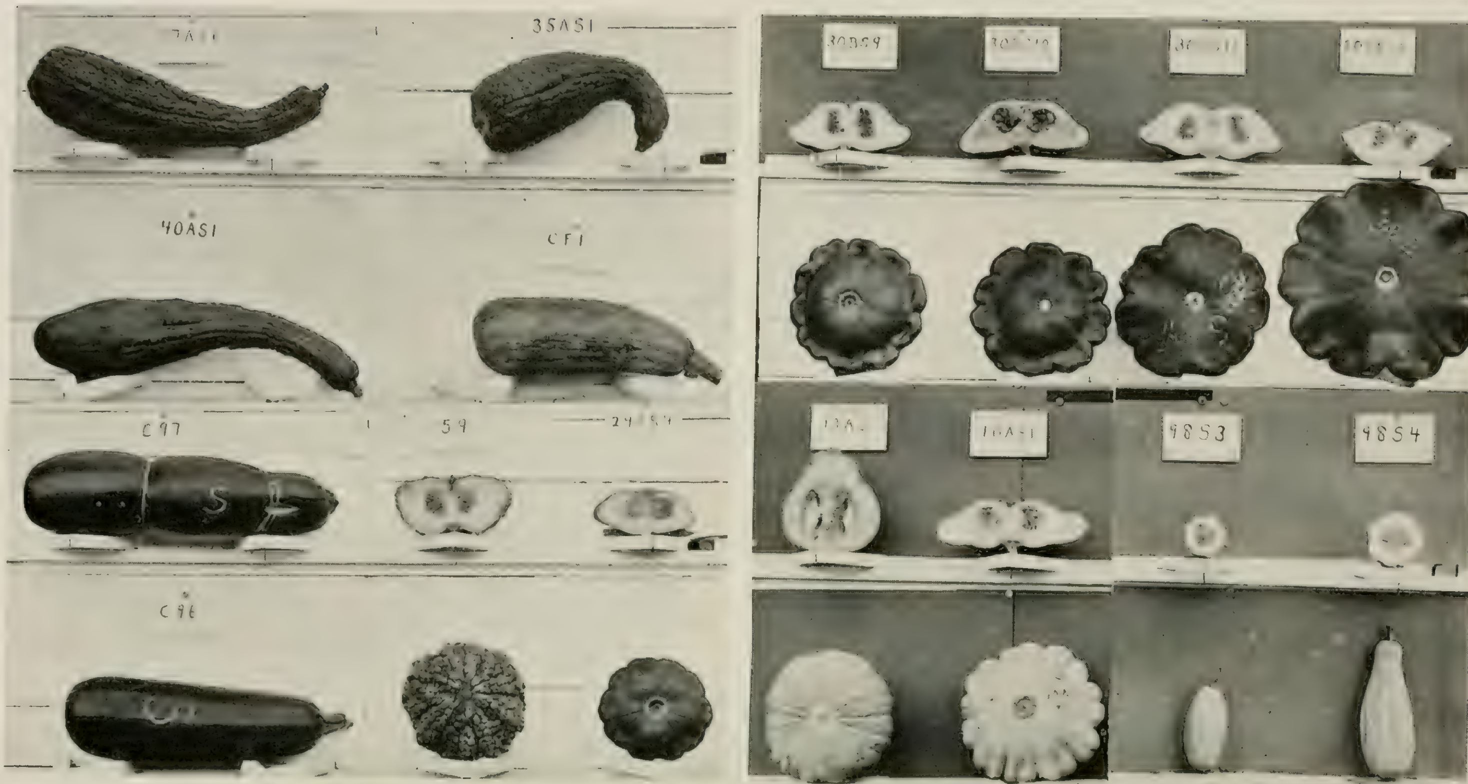
Two recent papers, however, should be especially noted. Drude[1] has reported the results of a long series of crosses in the Cucurbitaceae, chiefly among forms of *Cucurbita pepo*. He states that some characters show Mendelian inheritance but makes no extended analysis. His results show that white fruit color is evidently dominant over yellow or green and that wartiness is dominant over smoothness. He believes that many characters are not inherited in a Mendelian fashion and that reciprocal crosses are frequently dissimilar. A thorough mixture of the six types of summer squash with which he worked shows that certain of these types tend to persist in the offspring whereas others are entirely lost. Lotsy[2] reviews the work of previous writers and has made some extensive crosses among certain of the forms of *Cucurbita pepo* as well as in other species. He does not present much information as to the behavior of particular characters, but is especially concerned with interfertility among the different species and varieties. He confirms Drude's statement that in certain cases the results of reciprocal crosses are dissimilar.

All workers call attention to the extreme difficulty of effecting self-fertilization in the squash and to the sterility and lack of vigor shown by plants grown from inbred seed. In no case, therefore, have pure lines been established, or material known to be homozygous used in hybridization experiments. This fact of course casts a certain degree of doubt over the results heretofore reported in squash breeding experiments.

In 1916 the senior author grew several hundred plants of summer squash including all the commoner commercial varieties—croockneck, yellow and white scallops (patty-pans), Fordhook, marrow, and cocozelle. Seeds were obtained from four prominent seed firms. As is often found to be the case with summer squash, the plants showed a marked degree of variability and many of them did not come true to name. Some preliminary hybridizations were made, but it soon became clear that until reasonably pure types had been isolated, the results of hybridization experiments would be valueless. In something over one hundred plants of the types which seemed to be the most constant, per-

[1] Drude, O., Erfahrungen bei Kreuzungsversuchen mit *Curcurbita pepo*. *Ber. Deutsch. Bot. Ges.*, XXXV:26–57. 1918.

[2] Lotsy, J. P., Curcurbita-Strijdvragen. De soort-quaestie. Het gedrag na kruising. Parthenogenese? I. Historisch overzicht. II. Eigen onderzoekingen. *Genetica*, I: 497–531. 1919: II: 1–21. 1920.



TYPES OF SUMMER SQUASH

FIGURE 17. All amateur gardeners who have grown summer squash are aware of the great diversity found in plants raised from a single package of seed. The reason for this is the extreme difficulty of establishing pure strains of squash, as self-pollenated plants are nearly all sterile, and the few plants that do grow are seriously lacking in vigor. However, there is found to be considerable variation in the self-sterility of different plants, and by self-pollenating a sufficiently large number it has been possible to find plants that were not sterile, and whose progeny was sufficiently robust to develop pure lines having normal fertility. (See text, p. 177.)

sistent attempts were made to obtain good seed through self fertilization. A plant was watched until a male and a female flower bud were found which were almost ready to open. These were either bagged or their corollas tied up and on the succeeding morning pollen was transferred from anthers to stigma and the flower bagged. After a few days, when the corolla had withered or fallen, the bag was removed and the young fruit tagged. As a check, when the fruit was about half grown an "S" with the plant's number (or in crosses, the numbers of the parents) was scratched with a pencil on its surface and the scratch developed a corky ridge which marked the mature fruit clearly.

In the case of twenty-five of these plants, self-fertilization was successfully effected and fertile seed produced. In a number of others, fruits were set but the seeds were weak and failed to germinate. This result agrees with that of other breeders who find a high degree of self sterility in this species.

In 1917 several hundred plants were raised from this inbred seed. Although in a number of cases the offspring resembled their parents rather closely, in most instances a certain degree of variability was still evident in many plant characters, showing that the parent plants had been heterozygous. Most of the plants grown subsequently from commercial seed have also been found to be heterozygous.

In 1917 a number of these inbred types refused to set seed when selfed and one or two others have been lost subsequently. In every case these strains were replanted in the following season from reserved seed and the same result obtained, showing clearly that sterility or lack of vigor, and not seasonal or other environmental differences were the causes of failure. The other inbred lines have persisted through six seasons of inbreeding and show no lack of fertility. In vigor, many of them are somewhat inferior to heterozygous plants, but they have now apparently reached a point where they are maintaining themselves without further loss of vigor or fertility.

From year to year these inbred lines have become more constant and uniform. From five hundred to a thousand plants have been grown each year and a wide variety of types have been inbred, with the result that at present we have a considerable number of families which are apparently almost completely homozygous and may well be called pure lines. New commercial material has also been grown and inbred each year.

By 1919 most of the original types were breeding so true that there was reason to believe that they were essentially homozygous. In this season, therefore, crosses were made between various pure types involving the more important character differences. In 1920 a small F_1 generation was raised from 20 of these crosses. In every case but one, this was very uniform, thus confirming the belief that both parents were pure. During the past summer (1921), an F_2 generation of from fifty to one hundred plants was grown from each of these F_1 types. From a study of these two generations of crosses, and of the segregation which took place in the first few generations of inbreeding, we are now in a position to understand some of the facts involved in the inheritance of several of the more important characters of the plant.

BODY COLOR OF FRUIT

Fruit color is perhaps the most conspicuous plant character in Cucurbita. There are three main groups of fruit body color; the whites (Fig. 18), the yellows (Fig. 17, 30BS9–12), and the greens (Fig. 19, CF1, C97, C96, and 24AS4). Each of these may occur in different intensities, but no plant has been found which could not be referred definitely to one of the three. During the early generations of inbreeding, in the development of the pure lines, yellow fruited plants and green fruited plants appeared rather frequently in lines where the parents and the great bulk of the plants were white fruited; and green fruits have appeared in yellow fruited lines. White fruits have never arisen in yellow or green lines, nor yellows in green lines. This

of course suggested that white is dominant to yellow and yellow to green. This conclusion was fully borne out by the results of crossing. In Table I are presented the data for parents, F_1 and F_2 in nine pedigrees from crosses involving differences in fruit color.

The dominance of white over yellow and of yellow over green is evident. In pedigrees 17 and 6 there is an approximation to a 3:1 ratio of white to yellow in the F_2; and in 3 and 4, an approximation to a 3:1 ratio of yellow to green. Dominance of yellow over green is not quite complete. The F_1 in pedigrees 3 and 4 and a majority of the yellow segregates in the F_2 (presumably the heterozygous ones) are somewhat washed or tinged with green.

Pedigrees 1, 14, and 15, however, differ from the first four in the fact that a few green plants made their appearance in the F_2. The total number of plants in these three pedigrees is 205, of which 155, or almost exactly 3/4, are white. Of the 50 non-white plants, 40, or a little over 3/4, are yellow, the other 10 being green. This count (155:40:10) is very close to a 12:3:1 ratio, according to which we should expect in the population under discussion 154 white, 38 yellow and 13 green. It is evident that in pedigrees 6 and 17, the white parents contain hypostatic yellow factors and have a genotype which may be represented by the formula WWYY. Such plants when crossed with yellows could never throw any greens. In pedigrees 1, 14, and 15, however, the white parents evidently do not contain hypostatic yellow and apparently have the genotype WWyy. Such a plant when crossed with pure yellow (wwYY) would give WwYy in F_1 and 12/16 white, 3/16 yellow and 1/16 green in F_2, the result which we observed.

In pedigrees 5 and 7, however, there is a great preponderance of white in the F_2, a total of 64 white to 2 yellow. In several cases, also, the yellows which have appeared in white fruited lines during inbreeding have constituted considerably less than a quarter of a given group of offspring. We evidently have here two independent factors for white, W_1 and W_2. A white homozygous for both these would of course give, when crossed with a yellow, 15 white to 1 yellow in F_2, a ratio which is close to that which we found in these two pedigrees.

As responsible for the various body colors in the fruits of these squashes we may therefore assume two separate, dominant factors for white; a factor for yellow recessive to white and dominant over green, and a fundamental recessive factor for green.

In each of these main color types there is much variation. There are buff, cream, and plain whites, deep and light yellows, and greens. These are definitely inherited but the mode of inheritance is hard to trace. Evidently a number of modifying factors are here at work.

STRIPING OF FRUIT

In several of the lines fruit color is not uniform, but stripes differing in color from the body appear in the furrows (Fig. 18). Yellow and green stripes have appeared in lines normally

TABLE I. *Inheritance of Body Color in Fruit of Summer Squash*

Pedigree	Parents	F_1	F_2		
17	White × Yellow	White	White 73,	Yellow 19	
6	Yellow × White	White	White 25,	Yellow 9	
3	Green × Yellow	Yellow		Yellow 42,	Green 16
4	Yellow × Green	Yellow		Yellow 39,	Green 13
1	Yellow × White	White	White 66,	Yellow 20,	Green 3
14	Yellow × White	White	White 13,	Yellow 3,	Green 1
15	White × Yellow	White	White 76,	Yellow 17,	Green 6
5	White × Yellow	White	White 31,	Yellow 2	
7	White × Yellow	White	White 33,	Yellow 0	

solid white in color and green stripes have appeared in yellow lines. Striped plants have always bred true to striping after it has appeared, thus indicating that it behaves as a recessive character. Green striped plants have appeared in yellow striped lines, but never yellow striped plants in green striped lines, thus suggesting that the relation of yellow to green in stripe color is similar to that which holds between them in the body color of the fruit. Indeed, the stripe seems merely to be a region in the fruit where the dominant body color is inhibited in its expression and where the recessive color is thus able to manifest itself. The color of the stripe will therefore depend on the genetic constitution of the plant. In the case of a white fruit, the stripe will be yellow if the fruit has hypostatic yellow in its genotype, but if this is absent the stripe will be green. That this conclusion is correct is indicated by the fact that lines with white fruits showing green stripes have been proved, through breeding analysis, to contain no yellow.

In a number of cases in yellow and green fruits, stripes of the same color as the body but deeper in shade occur in the furrows. We are probably concerned here with an effect of the striping factor on those factors which modify the intensity of the body color.

Striping was involved in four crosses, the results of which are given in Table II.

In pedigree 21, where green striped was crossed with plain white, striping clearly behaves as a recessive and seems to be due to a single factor difference. In the other cases, where white with yellow stripes is crossed with plain yellow, difficulties arise. The absence of striping, brought in by the yellow, is clearly not dominant, for the F_1 in every case shows stripes. In the F_2, however, there are a considerable number of unstriped whites and most of the yellows are unstriped. It should be noted that in pedigrees 5 and 7, where we have shown that there are probably two independent factors for white, the yellow stripes (perhaps because of the excess of white) are pale and in some cases are barely distinguishable; so that possibly some of the plants recorded as plain white may actually possess very faint stripes. It is also possible that the factor for plain color brought in by the yellow is recessive to striping. The majority of extracted yellows, however, are not striped, and the further possibility suggests itself that there may be linkage between the factor for white and the factor for striping.

It is evident that plain white is dominant over striping, with a single factor difference involved. The relation between striping and plain yellow, however, is not entirely clear.

SURFACE OF FRUIT

In certain of the lines, the fruit surface is entirely smooth; in others it is very warty (Figs. 17 and 18); and in still others it shows only a few warts, scattered here and there (Fig. 17). Smooth fruited plants have always bred true, but warty ones have some-

TABLE II. *Inheritance of Striping in Fruit*

Pedigree	Parents	F_1	F_2
21	White, green striped × Plain white	Plain white	Plain white 43; White, green stripes 9
5	White, yellow striped × Plain yellow	White, pale yellow stripes	White, pale yellow stripes 23; Plain white 8, Plain yellow 2
6	Plain yellow × White, yellow stripes	White, yellow stripes	White, yellow stripes 22; Plain white 3; Yellow, stripes darker 3; Plain yellow 6
7	White, yellow striped × Plain yellow	White, pale yellow stripes	White, pale yellow stripes 20; Plain white 13

OTHER SQUASH VARIETIES

FIGURE 18. One of the most important points proved by this study is, that reciprocal crosses of the different varieties of squash are alike. It had been reported by other investigators that they were different. This was doubtless due to failure to procure pure lines of the varieties used. It has also been shown that the inheritance of the characters studied followed the known laws of heredity, another point questioned by earlier investigators. (See text, p. 177.)

times thrown smooth or nearly smooth types when inbred, thus suggesting that wartiness is dominant over smoothness. Wartiness is not a simple character, however, for it shows all degrees of development from one or two small spots to a surface completely covered with warts. It is very difficult to grade these types satisfactorily, so that in the records here presented they are all grouped together as "warty." The results of five crosses are set forth in Table III.

In pedigrees 1 and 8, a single factor difference between warty and smooth will evidently explain our results, there being 126 warty plants to 44 smooth ones in the F_2. It is noteworthy that the warty parent in both these cases was only moderately warty. In pedigrees 13, 18, and 22, on the other hand, there is a great deficiency of smooth plants in F_2, and a much closer approach to a 15:1 ratio than to a 3:1. The warty parents in these three cases were extremely warty, much more so than in the first two pedigrees. In the F_2, wartiness was present in all degrees, but it was noticeable that plants as extreme as the original warty parent were rare and that the great majority resembled the F_1 in being only moderately warty. In these cases, wartiness seems to be caused by two independent factors, cumulative in their effect. The pure types which show an intermediate degree of wartiness evidently possess only one of these factors.

FRUIT SHAPE

Evidence as to the manner of inheritance of fruit shape in these crosses has been presented elsewhere in some detail by the senior author,[3] but may be briefly summarized here. Most of the pure lines isolated showed the "scallop," (patty pan), or disc type of fruit, much broader than long (Figs. 17 and 18). In two of these lines there several times appeared, as a result of inbreeding, plants with fruits almost spherical in shape (Fig. 18, 45AS5, Fig. 17, 13AS). These forms subsequently all bred true, thus suggesting that the spherical type is recessive to the disc. Four crosses between the disc and the sphere shapes were made, the results of which are presented in Table IV.

These factors show clearly that there is a single factor difference between disc and sphere, the F_2 ratio being almost exactly 3:1 (254:85). The disc shape is completely dominant, the F_1 showing no trace of thickening. The extracted F_2 spherical plants, however, are not all alike but show an effect derived from the disc parent, those coming from crosses in which the disc parent was relatively flat being some-

TABLE III. *Inheritance of Fruit Surface*

Pedigree	Parents	F_1	F_2
1.........	Smooth × Warty	Warty	Warty 64, Smooth 24
8.........	Smooth × Warty	Warty	Warty 62, Smooth 20
13.........	Warty × Smooth	Warty	Warty 97, Smooth 6
18.........	Warty × Smooth	Warty	Warty 69 Smooth 6
22.........	Warty × Smooth	Warty	Warty 81, Smooth 7

TABLE IV. *Inheritance of Fruit Shape*

Pedigree	Parents	F_1	F_2
1.........	Disc × Sphere	Disc	Disc 79, Sphere 29
15.........	Sphere × Disc	Disc	Disc 83, Sphere 18
19.........	Disc × Sphere	Disc	Disc 41, Sphere 13
23.........	Disc × Sphere	Disc	Disc 51, Sphere 25

[3] SINNOTT, EDMUND W., The Inheritance of Fruit Shape in *Curcurbita pepo*. *Bot. Gazette*, LXXIV:95–103. 1922.

what flattened spheres, those derived from thicker discs not showing such flattening. In addition to the single large factor which causes the difference between sphere and disc shapes, there seem other independent factors which affect fruit shape in the same general way but to a slighter degree.

The great variety of other fruit shapes in the summer squash is doubtless due to many other factors, and a more complete analysis of the problem of fruit shape in these plants has been undertaken.

FLESH COLOR OF FRUIT

Considerable difference exists between the various pure lines as to the flesh color of their fruits. In some, this is pure white, the seed cavity and pulp having a slight greenish tinge. In others it is cream with yellow pulp, and in a few it is a deeper cream with a hint of reddish, the pulp being salmon. In plants with yellow fruit, the flesh color is almost invariably cream or salmon, but white fruits may have flesh of any color. The extremes of color are readily distinguishable, but they grade into one another in such a way that the intermediate forms are often hard to classify.

During the course of inbreeding, cream fleshed plants have several times arisen from white fleshed ones and subsequently bred true. No instances have been found, however, of a white fleshed type originating from a cream fleshed family.

Figures as to the inheritance of flesh color in seven crosses are set forth in Table V.

In the first four of these, white is clearly dominant and seems to differ from cream by a single factor, the F_2 approximating three whites to one cream. In the last three pedigrees, however, the dominance of white is not so complete, for although the F_1 is here recorded as white, the white has a very slight creamy tint. In these pedigrees, also, white and cream occur in about equal numbers in F_2. In these cases it is noteworthy that the cream fleshed parent was a yellow squash, whereas in the first four pedigrees it was a white squash. Flesh color evidently behaves differently in different cases, and we may perhaps assume the operation of two different kinds of factors for cream, as well as of factors modifying the intensity of the color.

BLOSSOM END

Plants differ markedly in the size and character of the scar at the blossom end of the fruit where the corolla fell off. This may be large or small, shallow or deep. Perhaps the most striking difference, however, is that between the single (Fig. 18, 85BS1–4), and the double (Fig. 18, 8BS2–5), the scars of the stigma and of the corolla being united in the former and separated by an area of smooth pericarp in the latter.

Pure lines differ in the character of the blossom end, some being invariably single and others always wide and double. Certain lines, however, are intermediate, some plants being single and others narrowly double with only a small smooth area between the scars. The two types may even be found on different fruits of the same plant, and the character is thus probably easily susceptible to environmental differences. During inbreeding, single types

Table V. *Inheritance of Flesh Color in Fruit*

Pedigree	Parents	F_1	F_2
8	Cream × White	White	White 64, Cream 18
18	White × Cream	White	White 67, Cream 27
22	White × Cream	White	White 74, Cream 19
23	Cream × White	White	White 60, Cream 12
1	Cream × White	White	White 50, Cream 37
15	White × Cream	White	White 48, Cream 49
17	Cream × White	White	White 40, Cream 51

have frequently arisen from doubles and doubles from singles.

A number of crosses involving differences in blossom end are reported in Table VI.

Although a study of the pure lines shows that this character is doubtless inherited, there is evidently a good deal of difference in the manner of its inheritance. We may say in general that the single type tends to be dominant over the double and to be more abundant in the F_2.

HABIT OF VINE

No well marked running vines were developed in the pure lines studied, but in a number of lines a distinct tendency to run was observable and gave a very different habit to the plant from the normal "bush" type. In crosses of the bush form with the runner, the F_1 showed a rather intermediate condition and in the F_2 there was a marked preponderance of bush plants. In many cases, however, the line between the two types was very hard to draw.

OTHER CHARACTERS

A number of other characters are distinctive of particular lines and are therefore clearly inherited, but their expression is difficult to record and no definite data as to their manner of inheritance has been gathered.

Such a character is that of highly developed teeth in the "starfish" type shown in (Fig. 18). The number of teeth and the development of the shelf or border around the fruit are also distinctive (compare plant at left with two plants in middle of lowest tier in Fig. 18).

The deeply furrowed surface seen in 85BS3 (Fig. 18), is a very constant feature of this line.

The "dome" shape of the fruit is perfectly constant and even tends to segregate out somewhat in crossing.

The size of the seed cavity may be relatively large, as in most plants, or relatively small. These differences are clearly characteristic of their respective lines.

The size, shape, and color of the seed are clearly inherited.

The size of the blossom end scar varies greatly, regardless of whether it is single or double. It may be little more than a small button or it may be large and conspicuous. In some cases, notably the "85" series (Fig. 18), it is very deep, running well down into the fruit. Usually, however, it is rather shallow.

Leaf characters also distinguish particular lines. The leaves may be three, five, or seven lobed, or may be almost unlobed. They may be erect and closely arranged on the stem, giving the plant a very bushy appearance; or they may be spread out more loosely.

Finally, there are differences in amount and character of fruit yield, some plants being heavy yielders and others relatively light ones. Certain types produce only one or two large fruits and others a considerable number of smaller ones.

It should be noted that in all the characters which have been studied in crosses, it makes no difference whether the character is brought in through the male or the female parent, reciprocal crosses being essentially similar. This result is directly at variance with those reported by Drude and Lotsy.

TABLE VI. *Inheritance of Blossom End*

Pedigree	Parents	F_1	F_2
1.........	Double×Single	Single	Single 80, Double 8
10.........	Single×Double	Single	Single 29, Double 11
17.........	Single×Double	Both	Single 71, Double 21
19.........	Double×Single	Both	Single 27, Double 26
21.........	Double×Single	Single	Single 27, Double 24
22.........	Double×Single	Both	Single 34, Double 55
23.........	Double×Single	Single	Single 70, Double 3

With the possible exception of the relation between striping and white body color, no definite case of linkage has been found.

SUMMARY

1. Self fertile strains in the summer squash have been found and a number of pure lines established.

2. In crosses between these pure types, information as to the inheritance of various plant characters has been gained.

3. In body color of fruit, white is dominant over yellow and yellow over green. There may be two independent factors for white, and there are evidently various modifying factors for color.

4. Plain (solid or self) color of fruit is dominant over striping in some cases but appears to be recessive in others. A single factor difference is involved.

5. In fruit surface, wartiness is dominant over smoothness, and may be caused by at least two independent factors, cumulative in their effect.

6. The "disc" shape of fruit is dominant over the "sphere," the main difference being due to a single factor, although one or more other factors may produce minor effects.

7. In flesh color of fruit, white is usually dominant over cream and salmon, and a single factor difference seems to be involved, but there are apparently several types of flesh color and these may behave differently.

8. Single blossom end scar tends to be dominant over double, though these characters vary greatly in inheritance and seem also to be readily modified by the environment.

9. Habit of vine and shape and arrangement of leaves are clearly inherited as also are, in the fruit, the number and character of teeth; type of "border"; furrowing of surface; certain characteristic shapes; size of seed cavity; size, shape, and color of seed; depth of blossom end scar; size of fruit; and yield, together with other characters. The exact manner of inheritance of all these, however, is as yet not clearly established.

Books Received

Principles of Social Psychology, by J. M. Williams, the Alfred Knopf Co., New York, 1922.

Early Civilization, by A. A. Goldenweiser, Alfred Knopf Co., New York, 1922.

The Home of the Indo-Europeans, by J. Bender, The Princeton University Press, 1922.

The Glands Regulating Personality, by Louis Berman, the Macmillan Co., New York, 1922.

Man, The Animal, by W. M. Smallwood, the Macmillan Co., New York, 1922.

BREEDING OATS RESISTANT TO STEM RUST[1]

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THE use of resistant varieties of field crops is being advocated as one of the chief means of disease control. Frequently resistance exists in a variety otherwise unimportant. Before it can be fully utilized this resistance must be combined with desirable economic characters from other varieties. In case resistance is a recessive character all plants of the desired type are selected in the F_2 generation and tested in later generations, since the only sure means of determining the value of a plant is to grow and examine its progeny. If resistance is dominant, however, it is impossible to distinguish the homozygous from the heterozygous plants in the F_2 generation, consequently another generation must be grown before selections can be made.

SUSCEPTIBLE AND RUST-RESISTANT OAT LEAVES

FIGURE 19. Notice the large blister-like pustules of the rust on the leaf of the susceptible variety (Victory), shown on the left. White Russian (center) is a resistant variety; the small, abortive pustules that can be seen develop under extreme epidemic conditions, but appear to do no harm. On the right is shown the leaf of a hybrid between Victory and White Russian oats. All the plants are resistant, which shows that resistant is dominant and susceptibility recessive, since the plants of the first hybrid generation show dominant characters only. (See text, p. 188.)

In the work of breeding cereals for rust resistance at the Minnesota Agricultural Experiment Station the purity of F_2 plants is determined on the basis of F_3 seedling tests made in the greenhouse. This work is carried on co-operatively by the Section of Plant Breeding of the Division of Agronomy and Farm Management, the Section of Plant Pathology of the Division of Plant Pathology and Botany, and the Office of Cereal Investigations of the United States Department of Agriculture. The method used is well illustrated by the results obtained in greenhouse tests used in breeding oats resistant to stem rust, *Puccinia graminis avenae* Erikes. and Henn.

In 1921, 600 F_2 plants, which appeared resistant to rust under an artificially induced field epidemic, were harvested at University Farm. These plants were a part of the progeny of the crosses of White Russian, a variety of oats resistant to stem rust, with Victory and Minota, susceptible varieties. It was reported by Garber[3] that in

[1] Published with the approval of the Director as Paper No. 329 of the Journal Series of the Minnesota Agricultural Experiment Station.

[2] Acknowledgment is due Dr. H. K. Hayes, Head of the Section of Plant Breeding, Division of Agronomy and Farm Management for suggestions and criticisms.

[3] GARBER, R. J., A Preliminary Note on the Inheritance of Rust Resistance in Oats. *Jour. Amer. Soc. Agron.*, XIII:41–43. 1921.

these crosses the F_1 generation is as resistant as the White Russian parent and in the F_2 generation segregation is according to the simple ratio of 3 resistant to 1 susceptible. A family of F_3 seedlings was grown from each of the 600 F_2 plants mentioned above. Twenty-five kernels of each plant were reserved for 1922 field planting and 25 or 30 of the remaining kernels were planted in the greenhouse. The kernels of each individual plant were planted separately in a 4-inch pot. The seedlings were inoculated with stem rust, and notes were taken about two weeks after inoculation on the type of infection obtained. Pots of White Russian and Victory seedlings were tested with each series of hybrid material and the type of infection carefully determined.

SEGREGATION FOR RUST RESISTANCE

FIGURE 20. In the second hybrid generation segregation occurs—all the plants are not alike, three that are resistant being found for every rusted one. The self-fertilized, rusted plants breed true, but only one third of the resistant plants do so. The progeny of the other two thirds segregating again in the next generation. It is impossible to tell the pure resistant (homozygous) plants from the impure (heterozygous) ones, so to separate them another generation must be grown. (See text, p. 187.)

The infection obtained on Victory in the greenhouse seedling inoculations is a 4± type[4] (see Fig. 19). This is the highest degree of infection obtained on any variety. The infection obtained on White Russian in the greenhouse is a 3± type. Under the most favorable epidemic conditions produced artificially in the field, numerous small uredinia, never larger than a pinhead, may develop on White Russian. Under ordinary field conditions in years of severe rust epidemics, White Russian is comparatively free from rust. A very few small uredinia may develop but no damage from them is apparent, while susceptible varieties growing in adjacent rows become very heavily infected, the culms being literally covered with confluent uredinia.

The number of F_3 families which bred true for resistance came very close to expectation (see Table I). In the cross White Russian x Victory, 82 F_3 families out of 229 families tested bred true for rust resistance. This gives a ratio, per 3 of 1.07:1.93 which is very close to the expected 1:2 ratio. In the cross Minota x White Russian and the reciprocal, 110 families out of 338 tested bred true for rust resistance. This is a ratio, per 3, of 1.01:1.99.

Since it is possible to obtain large numbers of homozygous resistant plants, the heterozygous F_2 plants may be eliminated on the basis of F_3 seedling tests in the greenhouse.

All families in which segregation occurred in F_3 were grouped and the ratio of resistant to susceptible seedlings was calculated (see Table II). The deviation from the expected 3:1 ratio is quite large in each case. The discrepancies are no doubt due to errors in taking data. The type of infection obtained on White Russian is a 3± type, and that obtained on Victory or Minota is a 4± type (see Fig. 19). It is quite possible that in some cases the uredinia had not fully developed when notes were taken and accordingly some seedlings were classed as a 3± type which a day or so later would have been a 4± type.

[4] The use of these symbols was suggested by Stakman and Levine.

SEGREGATION OF THE PROGENY OF THE RESISTANT SECOND GENERATION PLANTS

FIGURE 21. In order to separate the pure resistant (homozygous) plants of the second generation from those that carry susceptibility recessively (Figure 20), a few seeds of each resistant second generation plant are planted in the greenhouse. These seedlings when only a few weeks old are inoculated with rust spores. Some families are found to be entirely resistant, but in others rusted individuals are found. The pure, resistant families are planted in the field, while the others are discarded. The greenhouse test reduces the number of lines to be grown to one-third what would otherwise be necessary, and homozygous resistant plants are obtained for field selection a year earlier. (See text, p. 188.)

In making seedling inoculations, two methods were used. The first was the ordinary hand inoculation method. This consists of first wetting the seedling and then spreading uredospores on the lower surface of the seedling leaf with a small scalpel. Seedlings are then placed in an incubation chamber for 48 hours. The second was the brushing method[5] used for inoculating plants to produce a quantity of inoculum. In this the seedlings are sprayed with water and then brushed lightly with rusted seedlings. The incubation

TABLE I. *Numbers of F_3 Oat Families Segregating or Breeding True for Resistance to Stem Rust, and a Comparison of Obtained and Expected Ratios*

Cross	Resistant	Segregating	Ratio per 3		Dev.	P. E.	Dev. / P. E.
			Expected	Obtained			
White Russian x Victory.....	82	147	1:2	1.07:1.93	0.07	±0.06	1.2
Minota x White Russian.....	45	103	1:2	0.91:2.08	0.08	±0.08	1.0
White Russian x Minota.....	65	125	1:2	1.03:1.97	0.03	±0.07	0.4
Minota x White Russian and Reciprocal (Summary).....	110	228	1:2	1.01:1.99	0.01	±0.05	0.2

TABLE II. *Numbers of resistant and susceptible Seedlings of All F_3 Families Segregating for Resistance and Susceptibility to Stem Rust, and Comparison of Obtained with Expected Ratios*

Cross	Resistant	Susceptible	Ratio per 4		Dev.	P. E.	Dev. / P. E.
			Expected	Obtained			
White Russian x Victory.....	1252	351	3:1	3.11:0.89	0.11	±0.03	3.6
Minota x White Russian.....	964	254	3:1	3.17:0.83	0.17	±0.03	5.6
White Russian x Minota.....	1064	321	3:1	3.08:0.92	0.08	±0.03	2.7
Minota x White Russian and Reciprocal (Summary).....	2028	575	3:1	3.12:0.88	0.12	±0.02	6.0

[5] First used by O. S. Aamodt at the Minnesota station in rust inoculations with wheat seedlings.

period is the same as for the first method. Uniformly good results were obtained with this method and it is much easier and more rapid than the ordinary hand inoculation method. The brushing method may be used in inoculating hybrid seedlings when the segregation for manner of reaction is easily determined.

SUMMARY

The method used at the Minnesota station for differentiating heterozygous and homozygous F_2 plants in breeding for rust resistance, when resistance is a dominant character, is to grow in the greenhouse F_3 seedling families from each resistant F_2 plant. These seedlings are inoculated with rust and from their reaction the F_2 plants which are homozygous for resistance are determined. In breeding oats resistant to stem rust 192 of the 567 F_3 families tested bred true for resistance. The greenhouse test, therefore, reduced the number of lines to be grown in the field the following season from 567 to 192.

The brushing method in which the seedlings are sprayed with water and then brushed with rusted seedlings, was highly satisfactory for producing inoculum and may be used as a means of inoculating hybrid families when the manner of reaction allows the segregation to be easily determined.

INTELLIGENCE AND SCHOOLING

A Review of Some of the Results of the Army Intelligence Tests

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NEARLY two million men in the army during the World War were given intelligence tests,[1] and at the same time a great deal of information about their history was secured. Some of this information makes it possible to answer afresh the question whether these intelligence tests measure innate ability, or merely reflect the amount of formal education or educational opportunity which one has had.

The amount of schooling—an imperfect measure of real "education," but obviously the only one available for the present purpose—was one of the facts noted on the examination cards. Great differences are naturally found among various groups. Nearly all officers have at least finished the eighth grade; about one-third of them are college graduates. "Of native-born white recruits, one-fourth are eighth-grade graduates who have had no further schooling; this is the schooling most frequently reported. More than half have gone no farther than the seventh grade; almost one-fourth have had more or less high-school training, while only 5.4%—one-twentieth—have entered college and 1.25% have been graduated. The white draft of foreign birth is less schooled; more than half of this group have not gone beyond the fifth grade, while one-eighth, or 12.5%, report no schooling. Negro recruits, though brought up in this country where education is supposedly not only free but compulsory for all, report no schooling in astonishingly large proportion (19% in the southern, 10% in the northern states); more than half the negroes from southern states have not gone beyond the third grade, and only 7% finish the eighth. In northern states, half do not go beyond the fifth

[1] Psychological Examining in the U. S. Army, ed. by Robert M. Yerkes. *Memoirs of the National Academy of Sciences*, Vol. XV, pp. 890. Government Printing Office, Washington, D. C. 1921.

grade, and about one-fourth finish the eighth."

Standards of schooling vary in different parts of the country so that, for example, the attainment of third grade in a rural negro school may not represent the same amount of accomplishment that it does in a white urban school. But such differences cannot be regarded as great enough to account for the large discrepancies in intelligence shown.

When the distributions of intelligence revealed by the army mental tests are compared with the schooling distributions for the same groups, "the following observation may be made: The better educated the group, the better is its record on the intelligence examinations; or, equally truly, the better the intelligence rating a group can make, the more education it has obtained. The only point on which this correspondence fails is that the northern negro draft group is better schooled though less intelligent than the foreign-born draft group; it is just in line with this discrepancy, too, that the southern negro group, lowest in each comparison, is nevertheless much farther removed from the others in intelligence rating than it is in schooling. The normal relation between the intelligence of a race and its interest in the training of its youth, one might say, has been upset by contact with a highly educated civilization, which has enormously increased the time the negro spends on education without correspondingly increasing his intelligence (as measured by these examinations). The position of army officers in the two comparisons also falls in line here; in each respect it holds the highest position, but is much farther separated from the other groups in schooling than it is in intelligence. This greatly increased education, in other words, is not accompanied by an equal increase in the intelligence rating; in the latter the distributions for officers and white draft still overlap appreciably, while schooling separates them quite sharply."

One crucial test of the independence of schooling and intelligence rating is to compare various groups which have the same amount of schooling—technically, to make this factor constant while measuring the variation of the other. The median scores in the alpha test, for groups which reported only four years of Grammar school training, are given in table I.

It will be noted that at this level of schooling, the foreign-born whites slightly surpass the natives. This difference, which disappears at higher levels of schooling, may be due to greater pressure in native American communities to continue in school; in part to better opportunities of schooling; moreover, native-born children who drop out of school at this stage are likely to do so in many cases because of inferior intelligence, whereas

Table I. *Median Alpha Scores for Groups Which Reported 4 Years of Grammar School Training*

	White draft, native born	White draft, foreign born	Negro draft, northern	Negro draft, southern
No. of cases	2773	355	312	356
Median score	23.4	26.6	19.8	8.4

Table II. *Median Scores for Groups Which Reported Eighth-Grade Schooling*

	White officers	White draft, native born	White draft, foreign-born	Negro draft, northern	Negro draft, southern
Number of cases	448	14,899	928	555	144
Median score	108.1	64.4	59.4	50.0	28.9

the foreign-born may be impelled by other reasons, such as need of earning a living.

The median scores in the alpha test for those who reported that they completed the eighth grade, but went no farther in school, are given in Table II.

The officer group is here sharply differentiated from the groups of men in the ranks, although, it must be remembered, the schooling of all is the same.

A similar relation holds at the high school and college levels, although here the foreign-born show at greater disadvantage compared with the native-born. Among college graduates, the native-born man in the ranks makes just about as good a showing as do the officers. It is plausibly explained that the intelligence necessary to graduate from college is requisite in an officer, but that college graduates—a highly selected group, amounting to no more than one in a hundred of the young men of the country—who find themselves, as a result of the draft, in the ranks are of the same order of intelligence as those of their number who became officers.

Another comparison that is decidedly illuminating is that between officers who got no farther than the eighth grade, and native-born white recruits who have a high school or college education. "Every recruit in the recruit group (13,943) has had more schooling than any officer in the officer group (660); the least educated recruit in the group has had a longer education than the best educated officer included"; and the men are of similar racial stock. The median scores of these groups are, officers 107.3, recruits 97.4. "It is evident, then, that the examination is measuring other qualities, in which officers stand above recruits, to a greater extent than it is measuring education."

The same relation holds good within the group of officers themselves. Here the medical officers have had the most schooling (15.8 years average), and the quartermaster officers the least (average 12.4 years); yet the latter surpass the former in average intelligence. Indeed, the officers of the medical department ranked, in points of intelligence, below all other officers in the army,[2] although they formed the group which, of all represented, had had the greatest amount of tuition.

The conclusion that differences in mental ability, as measured by modern intelligence tests, are innate and germinal, and that they represent not differences in education or environment, so much as differences of heredity, seems sound.

This fact of inherited mental differences is the very foundation of eugenics. Its confirmation with such a large body of material is of the greatest importance. Henceforth, those who advocate any method of permanent race betterment not based on eugenics can only plead indifference to facts.

[2] Intellectual and Educational Status of the Medical Profession as Represented in the United States Army. *Bulletin National Research Council*, No. 8, Washington, D. C., 1921.

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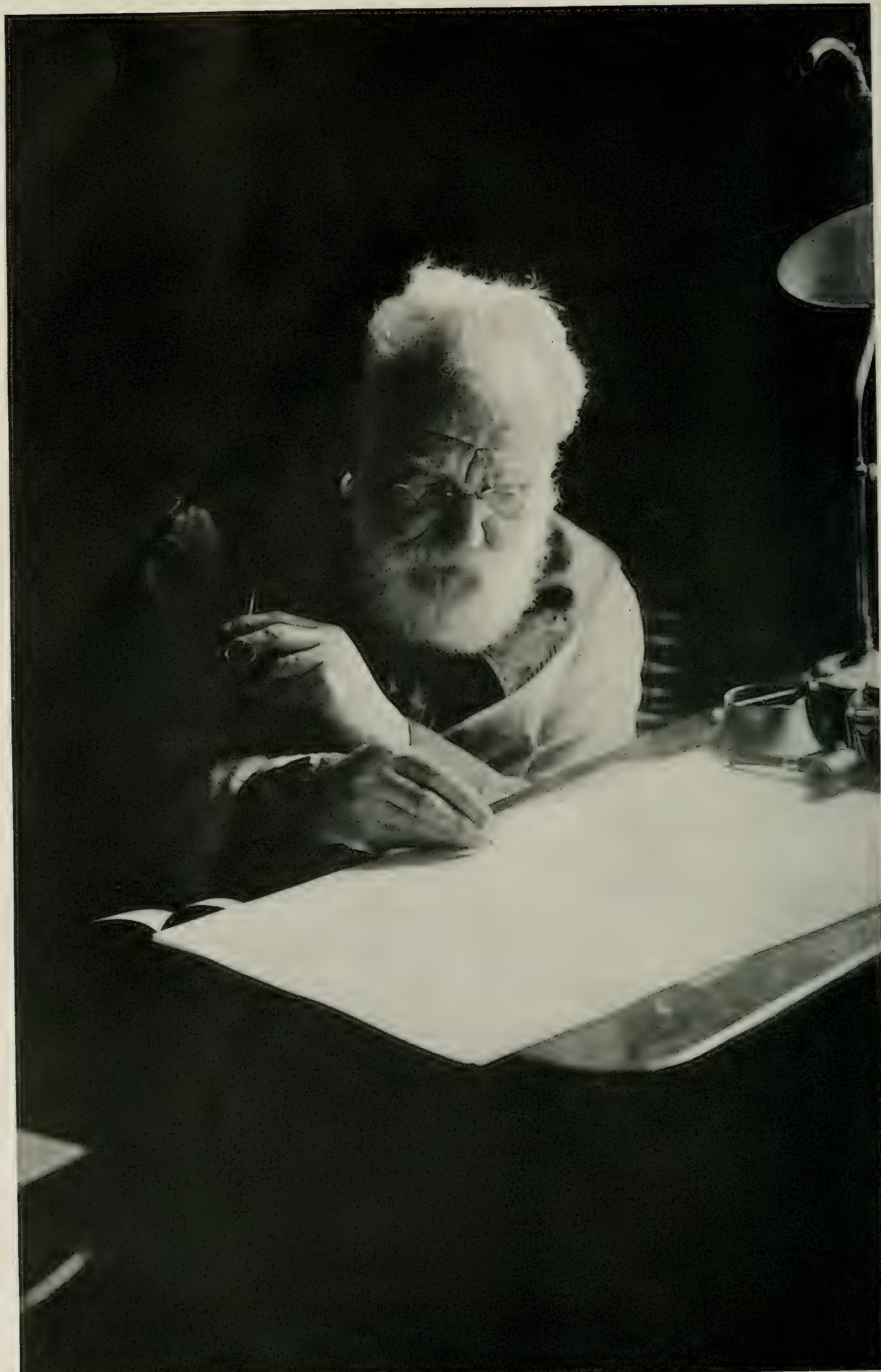

ALEXANDER GRAHAM BELL AT WORK

Mr. Bell in his dressing gown, pipe in hand, working as he worked for so many thousands of nights. With the stub of a pencil or a fine steel pen he, himself, wrote every one of the millions of figures upon which were based his two most important discoveries in heredity, the Possibility of the Formation of a Deaf Variety of the Human Race, and the Inheritance of Longevity. From few rooms in the world have there emanated more brilliant, constructive ideas than from this study in Washington.

ALEXANDER GRAHAM BELL

SOME CHARACTERS OF HIS GREATNESS

David Fairchild

TRIBUTES to the greatness of Alexander Graham Bell have been paid by millions of people, and few men have ever lived who have endeared themselves to so vast a multitude of their fellow men through the creations of their brains. His discoveries and his inventions have entitled him to all the homage which he has received, and it is wonderful to realize that the homage is not paid, as it is to military heroes, for protecting mankind from evil, but for the actual increase in happiness which his discoveries have brought.

There will be many to write of his accomplishments in the fields of electrical science, and there will be many tributes paid to him in the field of education, but as the years pass and the great science of genetics takes its place in those fields of intellectual activity which are recognized as contributing most to the cause of human happiness, Mr. Bell's clear vision of the greatness of the possibilities which lie in the study of the laws of heredity will come out into strong relief and demonstrate to the world what his most intimate friends have always known, that his was a super-brain possessed with a vision of the future which has been given to very few men.

Mr. Bell was for many years a member of the American Breeders' Association, a most valuable advisor in its reorganization into the American Genetic Association, an active member of its council for years, a financial backer of the new magazine policy inaugurated upon its reorganization and a constructive critic of the conduct of the Journal of Heredity in which he took a deep interest.

As his son-in-law, I was permitted to know Mr. Bell in an intimate way, and this intimacy makes it difficult for me to give, as I would like to give here, the kind of estimate of him which I think he would approve of were he still living.

His belief in the force of the laws of heredity, strengthened by his own researches into the inheritance of deafness and longevity, and his experience with his multinippled sheep was so great that I feel sure he would disapprove of anything which attributed his greatness to causes which were mystical in character. And in this tribute which I shall try to write as though I were going to submit it to him for approval, I shall dwell upon those things which seem to me to characterize him as the most unusual human being which it has been my fortune to know.

THE CLEARNESS OF HIS THINKING

It seems to me that the most characteristic thing about Mr. Bell was the startling clearness of his thinking. The thoughts of the average person, when expressed in words, often produce, as it were, a somewhat blurred image on the brain of the listener, but with Mr. Bell there never was any doubt in my mind as I listened to him that he had said what he intended to say. He had produced, as he intended, a brain pattern of a certain character in my own. I might not understand it, but if I did not it was because I was not sufficiently familiar with the facts. It never crossed my mind to question the clearness of his statement.

This clearness of his thinking seems to have characterized him even as a boy, for it shows itself strikingly in an article on resonance written when he was only eighteen years of age. I have never been able to think of it as other than a varietal character of his wonderful brain.

Coupled with this remarkable clearness of thinking was his unusual hearing and eyesight, and uniting them was an alertness of interest, which I have never seen equaled by any of my many friends. His mind seemed to penetrate to a deeper level than the usual, and almost always discovered something new which filled him with a wonder in which he took unfailing delight. I was sitting beside him in his study one day when his little grandchild came running in with a toy balloon in her hand to kiss him goodnight. He glanced up, turned to me, and said, "Isn't it wonderful! See how it rises!" To the ordinary mind there has ceased to be anything wonderful in a toy balloon's rising; it always rises, just as the sun does. But had there been in the past no brain to wonder why the sun rose we should still be living in the days of the flat earth and accept the simple hypothesis that the sun disappeared behind a mountain.

It always seemed to me that he delighted to wonder. Wondering to him was almost a passion. And because of the peculiar clearness of his brain and the keen interest which his mind took in the sights and sounds which went on around him, his wonderings led to the discoveries for which the world is indebted to him.

LOVE OF ISOLATION

Mr. Bell led a peculiarly isolated life; I have never known anyone who spent so much of his time alone. His hours of work were the night hours when everything was quiet. His summer home life was seldom interrupted by the usual social responsibilities which annoy most men of science. He had a secluded old houseboat moored on a picturesque beach on the Bras D'Or Lakes where for 25 years he spent many of his Saturdays and Sundays all alone listening to the waves which broke on the pebbly beach, and the quiet sounds of the wood animals in the firs and spruces around him.

It has always seemed remarkable that this isolation did not, as it has in so many cases, lead to a quieting down of his intellectual activities. Solitude seemed to stimulate them, and he would sparkle with new ideas after these periods of seclusion. It sometimes seemed as though he were restless to be alone with his own thoughts. So far as I can learn, this too was an early characteristic of Mr. Bell. It was an intellectual character of the man which made its appearance in the boy, and was not one of those habits which some men acquire in mature life.

His love of the night was perhaps another phase of his love of solitude; it was not only that he wanted the uninterrupted quiet of the night hours for work, but he loved to be out of doors at night roaming through the woods or walking on the city streets. Passionately fond of music he would often, after everybody else had gone to bed, sit down at the piano and play from the great composers for hours at a time. He was always at his best at night, while morning found him listless.

SENSE OF ROMANCE

Mr. Bell had what I have never met with in any other person to the same degree, a sense of the romance of everything that occurred about him; and he kept the romance of his life alive by writing down the occurrences of every day and later reading over to himself and to his friends what he had written. In this way he lived his life over at least twice. He preferred this to that greedier way of rushing on to the next event without really stopping to enjoy the retrospect of the last one, which is, we must all admit, the common way.

This habit of life, which nothing was ever allowed to interfere with, resulted in the accumulation of volumes of notes which make a most remarkable picture of the thought-life as well as the doings of this remarkable man. Just as the life of Benvenuto Cellini has allowed anyone who was interested to stand, as it were, and look over his shoulder as he wrote of the stirring things in the life of a sculptor of the

16th century, so these note-books of Mr. Bell will permit the world of tomorrow to follow the thoughts and the doings of a real discoverer in science of the 19th and 20th centuries.

Hidden in these note books will be found the accounts of attempts which he made again and again to penetrate into the unknown, attempts which, because they did not take him far enough or because they satisfied his own curiosity, or did not seem important enough, have never been written up for publication. These were not simply the ideas of an idle afternoon, but studies, some of which went on for years, such as the studies of gravitation, upon which he worked continuously for at least ten years, and his work with multinippled sheep, the records of which cover hundreds of pages of his note books and give detailed accounts of experiments which he carried on for twenty-five years.

These note books show the almost ceaseless activitity of Mr. Bell's wonderful brain. That it was in strikingly ceaseless activity during its waking hours and remarkably dormant when asleep, all of his intimate friends well know. There was a soundness in his sleep and a wakefulness in his waking hours which always seemed to have some connection with each other and can hardly be attributed in any way to his habits. They were, I believe, characteristics with which he came into the world.

HIS OPTIMISM

Critical of his own work, searching in his analysis of the work of others, Mr. Bell was never openly critical of people. During the seventeen years of my close association with him I never heard from his lips a single harsh criticism of anyone, and a gentle rebuke which he once gave me when I predicted the failure of a certain acquaintance still rings in my ears. I have often tried to discover his reason for never criticizing others. It could hardly come through any religious theories, for he was not in sympathy with religious dogma. Whether it came about through his early training, during which he went through a deep religious experience, or whether it was his clear understanding of the immediate effect which harsh criticism of others had on his own happiness, I do not know, but in any case he never did form that pernicious habit, and one of his favorite sayings was, "One should never impute unworthy motives to others."

As strongly characteristic as his abhorrence of personal criticism was Mr. Bell's unquenchable optimism. He often measured opinions by the direction in which they led, and if they landed him in inaction he considered them pessimistic and futile and he often met them with the remark that they were "destructive and not constructive."

He was optimistic by nature, but his optimism was much more than a response to his own feelings; it was the deep conviction of a life of remarkable observation and study. He never tore down or destroyed, he always tried to build up or construct.

Often when our conversation took a pessimistic turn during the war, Mr. Bell would take one of his long detached views of things and show how the general drift of Evolution was towards altruism.

EUGENIC THEORIES

To the members of the American Genetic Association who believe in the evolution of races of human beings who shall have on the average not only larger, better thinking brains, but who shall be morally as good as they are intellectually great, Mr. Bell stands as a remarkable example of the correlation which it is believed exists between intellectuality and morals. It is fascinating to contemplate the possibility of a world filled with human beings who could see as clearly as did Mr. Bell, the bearing of every action of the individual upon the happiness of all, and who could appreciate the responsibility of one generation towards the next and the tremendous bearing of

hereditary traits which slip down through generation after generation.

It was perfectly natural that one of Mr. Bell's deep insight into things should take a keen interest in matters of heredity and puzzle over them for years. Before anyone else had applied the modern statistical methods to an investigation of the working of its laws he burrowed into one of the most striking cases of human inheritance,—the inheritance of deafness, and later he took up in his characteristic way an investigation into the inheritance of longevity. His first study has put him in the rank of earliest explorers in the field of eugenics, and his later work has marked him as belonging to the positive eugenists who believe that the improvement of the human race will only come from the mating of the desirables, and that to stop the mating of the undesirables will not advance the race unless it is accompanied by the mating of the desirables.

He believed that you could not frighten people into doing the right thing by showing them the direful results of mismating but that you could lead them to marry the desirables by pointing out the possibilities which would result from such marriages. He viewed the whole problem of eugenics from the biologist's point of view rather than from that of the morbid anatomist and criminologist, and deliberately kept in touch with the wider background of genetics through his personal experiments with multinippled sheep. He was sometimes impatient with those who, from looking too long or too closely at the defective side of human life, failed to see that in the evolution of a species there would probably always be a certain percentage of defectives but that their presence did not warrant anyone in being pessimistic as to the ultimate fate of humanity.

SENSE OF THE SPECTACULAR

It always seemed to me that Mr. Bell, although interested in all sorts of speculation, kept always in the foreground of his mind the chief object of a scientific life—the accumulation of facts. He seemed more interested in getting at the actual facts then in building a theory, although he had the keenest sense of anyone I have ever known of the spectacular aspect of any new discovery.

This sense of the spectacular has always appeared to me to be an inborn trait responsible perhaps for his almost uncanny *flaire* with regard to what would interest a large number of people; it was what might be called his "news sense." His interest in photographs is reflected in the policy which Mr. Grosvenor has so successfully developed in the National Geographic Magazine and appears to me to be simply a part of the undimmed boyish curiosity to see things which made him carry a hand lens in his pocket for years and led him to wire me enthusiastically to go ahead in the preparation of a book of photographs of insects magnified from five to twenty diameters.

Born as he was with sensibilities much more acute than the usual, he kept them from becoming dulled, so that to him a candle flame, a flying bird, a foggy morning, calm streaks on the waters of the lake, the dropping of a cone on the roof, or a child who lisped had an interest which never wore away. If he walked through the bull-rushes on the edge of the pond near his house-boat he could not help gathering the seeds and trying to make a porridge out of them. The sphagnum moss of the bog near by made him wonder if he could not use it to make improvised clothes for himself, imagining he was a shipwrecked mariner on his beach.

The water running down the window pane on a cool morning did not escape his attention and after wondering, as he often told us, "all his life long" how fresh water could be condensed from a fog so that mariners at sea should not die of thirst, he at last devised two contrivances for condensing water at low temperatures. One of these embodied the principle of blowing air into a cold bottle and the other the dripping of a window pane.

In reading the life of Benjamin Franklin I have been struck by a certain similarity between the simple directness of intellectual attack which characterized Franklin's kite experiment in the thunder storm and those of Mr. Bell. The problems which they attacked were never trivial in character and they both appeared to take logical roads towards their solution and I cannot but attribute this similarity to a similar clearness of their mental processes.

REMARKABLE MEMORY

The ordinary biographies are so taken up with the accounts of a man's accomplishments that it is not easy to get at those things which actually characterized him as an unusual human being and I cannot discover whether, for instance, Benjamin Franklin had the word-memory which was so characteristic of Mr. Bell. It was natural for Mr. Bell to remember the exact wording of any letter which he had dictated, even though some time had elapsed since he wrote it, and to one with a poor word-memory such as I have, the storage house of his brain seemed like a tremendous library with every book on its proper shelf and catalogued. And it was not an effort for him to pull out the right book, either.

I say it was not an effort, but I would not give the idea that his brain was not only capable of tremendous effort but of almost incredibly sustained effort. I think he had an hypothesis that the brain took a certain time to get itself into working trim and that his own, after even 24 hours of continuous exertion could perform actually better than it could at the beginning. At any rate, he sometimes drove it for as much as 48 hours without stopping to give it rest and at the end of this time he felt it was going as well as at the beginning.

Throughout the whole period when I had the privilege of knowing him, his mind seemed either engaged on some line of thought or was resting itself in the excitement of a detective story. It was not as so many brains are, dawdling over the trivialities of human personalities or commonplace occurrences. It was manifestly a great brain and he kept it in constant activity acquiring knowledge. If there appeared in the newspaper an account of any strange natural phenomenon like the fall of a meteor or some unaccountable death, his quick eye was sure to see it and make note of it for the entertainment of the dinner table.

His curiosity was phenomenal and there seemed to be a strange fascination for him in a secret; it was sometimes amusing to see how his mind would come back to the subject of the secret after the matter had been left far behind in the conversation. This unquenchable, unflagging curiosity appeared to be a quality of his personality and was what made it possible for him to maintain his keen interest in everything even through months of comparative solitude.

LOVE OF COMPANIONSHIP

It would be a mistake to give the idea that Mr. Bell did not require companionship, for there never was a man who had more continuously by his side a congenial and immensely stimulating companion upon whom he was peculiarly dependent for intellectual support. How much the love and devotion of Mrs. Bell has been responsible for the long series of experiments and the many discoveries which Mr. Bell made, is evident from the feeling often expressed by his intimate friends that any life of Mr. Bell would have to include a life of Mrs. Bell as well, for her personality, quite as great in its way as his, formed the most important factor of any in the environment in which this great man developed and lived. Had his been a life of sordid care or one of unhappy family relations or even one of uncongenial surroundings, the output of scientific achievements must have been quite other than it was.

At their Cape Breton home he and Mrs. Bell have always welcomed all who came, and their cordiality is famous. But this has never been

allowed to interfere with the sacredness of Mr. Bell's solitude. He had his time for solitude and his time for social intercourse and the one was not permitted to interfere with the other.

HIS WEDNESDAY EVENINGS

His Wednesday evenings of scientific discussion which he held for over 20 years at his Washington home will be long remembered by all those who took part in them, for they constituted uniquely interesting gatherings of the scientific men of the world where important discoveries and researches were announced and discussed in a delightfully informal manner. Through these evenings he kept in touch with the important men of his time and gave pleasure and encouragement to hundreds of scientific men.

I remember as a boy reading of the last hours of Napoleon and the last words of Goethe and others, thinking to catch some glimpse of that great beyond, through these super-minds just as they fluttered on its brink. There has always attached somehow a strange importance to the last words of a great man, and I cannot close this imperfect sketch of the personality of Alexander Graham Bell without telling of the last conversation I had with him on a scientific subject, the night before his death, while his mind was perfectly clear. He complained of great lassitude and seemed to have that same clear conviction of what was coming in his life that he always had regarding natural phenomena, and I suggested to him in a question that possibly something had gone wrong with the electrical mechanism of his body and then inquired if he didn't think we were electrical organisms anyway. He shrugged his shoulders in an amused way and answered with a favorite phrase, "Je ne sais pas, Monsieur, Je ne sais pas."

And he has gone, passing as a wind passes over the moorland on a starry night, but there remain his discoveries, his descendants, and the marvelous memories which he has left in the lives of his host of friends.

A New Edition of Walter's Genetics

GENETICS, AN INTRODUCTION TO THE STUDY OF HEREDITY. By HERBERT EUGENE WALTER, Associate Professor of Biology, Brown University. Revised Edition. 354 pages. $2.25. The MacMillan Co., New York, 1922.

Since its first publication in 1915, Professor Walter's *Genetics* has been one of the most successful of the elementary text books on this subject. It is a thoroughly readable book, full of the apt illustrations and side lights which delight those who have the privilege of listening to Professor Walter's lectures. In the revised edition (1922) extensive changes have been made in order to bring the subject up to date. Three chapters have been added which deal with recent discoveries in regard to linkage, the problem of development and the determination of sex, the last with the assistance of Professor S. I. Kornhauser. Other parts have been rewritten. It is a book which can be recommended without hesitation to the general reader.

S. W.

The German Genetics Association

The Deutsche Gesellschaft für Vererbungswissenschaft held its annual meeting in Vienna from the 25th to the 27th of September, 1922. The meeting was arranged to follow immediately after the exercises of the Mendel centenary at Brünn, Sept. 22–24.

The three forenoons were given up to discussions of the problem of mutation, led by R. Goldschmidt; artificial changes in the mechanism of heredity, led by H. Spemann; and the inheritance of mental defects, led by E. Rüdin.

The general evening meeting was devoted to an address by E. Baur on "Methods and aims of genetics in theory and practice."

IMPROVED METHOD OF PROPAGATING THE LITCHI

BEVERLY T. GALLOWAY
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NEARLY every country has its premier fruit. In Java it is the mangosteen, sometimes called the "queen of fruits"; in India it is the mango; while in south China the litchi holds first place. Groff, in his recent book[1] on the litchi and longan, says:

"Travelers in China from the earliest times have reported the merits of the litchi and have encouraged its introduction into Europe and the United States. But like many things of Chinese origin, this important fruit is practically unknown in the Western Hemisphere."

There are many varieties of litchis, and doubtless numerous strains and types with shades of differences too slight to warrant varietal distinction. Fresh fruits of the litchi are rarely, if ever, seen in this country unless on the Pacific coast, and since the rigid enforcement of the plant-quarantine law they are practically excluded. Dried "litchi nuts," as they are sometimes called, are found in the Chinese stores and restaurants, and the canned or preserved fruit is not uncommon in our markets. Wilson Popenoe[2] says:

"The fruits, which are produced in loose clusters of two or three to twenty or more, have been likened to strawberries in appearance. . . . The flavor is subacid, suggestive of the Bigarreau cherry or, according to some, the Muscat grape."

The widespread use of the litchi in the warmer parts of the Orient, its delicious, sprightly subacid taste, and other desirable characters have led to many efforts to introduce it into the warmer parts of America. The seeds quickly perish, and this no doubt has served as a check on the introduction and spread of the crop throughout the world. The Chinese methods of propagation by inarching and layering are slow, the resulting plants, at least those which come to us, often being rough, misshapen, and very reluctant to develop new wood.

INARCHED AND ROOTED LITCHI PLANTS

FIGURE 1. The large plant at the left is 6 or 8 years old and is from China. The inarching is shown where the plant bends. The plant on the right was rooted from a cutting and is 1 year old. The Chinese method of propagation produces misshapen, unhealthy plants that develop very slowly. It is therefore of great importance that a method has been developed whereby healthy, rapid-growing Litchi plants can be propagated from cuttings. Photograph by E. L. Crandall. (See text, p. 206.)

[1] *The Lychee and Longan.* G. Weidman Groff, Canton Christian College, 1921.
[2] *Manual of Tropical and Subtropical Fruits*, 1920.

HUMIDIFIED PROPAGATING CASE—INTERIOR VIEW

FIGURE 2. Propagating case open, showing arrangement of pots on moss, labels for holding cuttings, and method of tying cuttings to labels. It takes about 8 weeks to run a lot of cuttings through, and get them rooted and sufficiently hardened to withstand ordinary greenhouse conditions. Photograph by E. L. Crandall.

HUMIDIFIED PROPAGATING CASE

FIGURE 3. The closed case is of wood with a hinged glass cover. This case rests on a galvanized iron pan 3 inches deep. The pan is filled with water heated by means of a coil of 4 rows of 1-inch pipe, a small boiler, and an oil lamp. The pan is supported on the coil. The coil and boiler are filled with water from an open standpipe at the back of the case. Over the pan is placed a false bottom of ¼-inch wire mesh covered with moss. Pots containing cuttings are set on the moss. The box must be made tight and the hinged cover fitted close in order to conserve heat and moisture. The temperature of the box must be kept at about 90° F., and the air saturated with moisture at all times. Photograph by E. L. Crandall.

UNROOTED AND ROOTED LITCHI CUTTINGS, NATURAL SIZE

FIGURE 4. Cuttings should be from mature but not old wood 6 to 8 inches long. As soon as cuttings are taken, immerse in water for 10 or 15 minutes. Tie the cuttings to 6-inch labels and shove into the soil in 3-inch pots so that the end of the cutting just touches the surface of the soil in the pot. The soil should be a mixture of clean, fine, black peat and white sand (three-fourths peat and one-fourth sand). Place the pots close together on the moss in the case. Keep the cuttings moist and *sweating* at all times. In from two to three weeks callus and roots will form, as shown in the illustration at the right. Photograph by E. L. Crandall.

ROOTED LITCHI CUTTINGS

FIGURE 5. A 3-inch pot containing a rooted litchi plant ready to remove from the propagating case. At the right is another plant without the pot to show the soil and roots. Great care must be taken in removing the plants from the case. There must be a gradual let-down in temperature, and for this purpose one or two unheated cases are needed. Photograph by E. L. Crandall.

For the past five or six years the Office of Foreign Seed and Plant Introduction has been giving attention to some of the problems involved in the introduction and spread of this valuable fruit crop. Experiments have been made in long-distance seed shipments, and numerous efforts have been put forward to discover ways of transporting budwood and scion wood and utilizing the same in more rapidly propagating new stock. The attempts to bring in budwood and scion wood from distant countries and to utilize this material for budding or grafting on strong seedling stocks have not been successful. Numerous methods of grafting the imported wood were tried, but failure marked most of these efforts. Attention was then turned to propagation by means of cuttings, in the hope that small plants might be

more quickly produced and more readily transported long distances. It was believed that if the cutting method was successful arrangements could be made with collaborators in countries where the litchi is abundant for the utilization of the practices worked out in securing large numbers of small plants for shipment here and to other parts of the world. We were particularly desirous of securing the cooperation of workers in China in this effort to extend the planting and use of the litchi.

It was found that three important factors were involved in the propagation of the plant by cuttings: First, certain mechanical appliances for securing uniform conditions of light, temperature, and humidity; second, suitable fresh litchi wood; and, third, a proper soil for the growing roots and the development of the new plant. To Edward Goucher, Plant Propagator in the Office of Foreign Seed and Plant Introduction, is due the credit for working out the details. Mr. Goucher's patience and painstaking care led to the development of the apparatus and the perfection of the method shown in the accompanying illustrations (Figs. 1–5).[3]

The Chemistry of Taste

Smell, Taste, and Allied Senses in the Vertebrates, by G. H. Parker, S. D., Professor of Zoology, Harvard University, 192 pages. In series of Monographs on Experimental Biology. J. B. Lippincott Co., Philadelphia and London, 1922.

All of the knowledge of the outside world out of which the structure of science has slowly been built, all of the activities, conscious or unconscious, of men and animals trace ultimately to stimuli received by the sense organs. The latter occupy the bridge-head between the outer and the inner worlds. Some understanding of their nature and functioning should thus be a subject of concern to all intelligent men. Professor Parker gives a survey of the present state of knowledge, both on the anatomical and the functional sides, of one group of sense organs, those which play the part of analytic chemists for the body. These include first the sense or senses of smell by means of which what seems to be an indefinitely large number of substances can be recognized often in unbelievably small traces, and secondly, the four senses of taste, through one of which the organism measures more or less roughly the hydrogen-ion concentration of substances which enter the mouth (the acid taste) while the others detect the presence of certain desirable or undesirable substances which the organism is likely to encounter in its food, viz: the salts of various inorganic acids (the saline taste), alkaloids (the bitter taste) and sugars or related substances (the sweet taste). We learn that these cellular chemists are not infallible. The sense organs whose prime purpose seems to be the recognition of sugars are deceived by various wholly unrelated substances like sugar of lead, saccharine and salts ofglucinum and similarly with those which detect alkaloids.

The little understood organ of Jacobson and the common chemical sense are discussed.

The book can be heartily recommended to those who wish an authoritative but relatively untechnical presentation of the subject.

S. W.

[3] The complete apparatus, shown in Figure 1, has been forwarded to Prof. G. Weidman Groff, of the Canton Christian College, Canton, China. Prof. Groff has been studying the litchi for a number of years, and through his efforts it is hoped to inaugurate this improved method of litchi propagation in China.

AS GENETICS COMES OF AGE

E. M. East

Bussey Institution, Harvard University, Forest Hills, Mass.

GENETICS was born twenty-one years ago when there came the first real appreciation of the studies on heredity made in the little garden at Brünn. Now that it has reached full manhood and is ready to assume the *toga virilis*, the time seems fitting to call back the yesterdays, to cast up accounts, and to judge whether the performance of maturity promises to repay the cost of infancy and childhood.

Perhaps it will serve our purpose to contrast the status of affairs toward the close of the long prenatal period previous to the twentieth century, with that of today. When one does this, he is convinced that our chance metaphor is really rather apt. When the chick breaks through the egg, when the butterfly bursts the chrysalis, when the rose bud opens, the change is superficially so revolutionary that one is likely to forget the intensive energy expended in preparation for the natal day. So also with the study of heredity. Genetics was born and christened because of Gregor Mendel. Not because he diligently gathered facts regarding the heredity of the garden pea; rather because he was able to analyze and correlate these facts. Others had gathered facts galore. Indeed the growth-curve of knowledge had been rising steadily for many years. Yet metamorphosis came only when mathematics began to be applied effectively to the efforts of physiologist and morphologist. Change in method rather than a single great discovery gave the first real insight into the master riddle of the ages.

EARLY STUDIES OF HEREDITY

Previous to the beginning of the twentieth century, isolated observations on heredity had been made by many types of workers. It was only natural that this should be the case. Such a seemingly mysterious force could hardly have failed to fascinate mankind from the very beginning of his speculative history. But isolated observations on subjects wherein are numerous complex variables, usually wait long for the keystone with which the generalizing mind can support an edifice of useful theory. And in this particular instance the time was undoubtedly extended by a striking aloofness and lack of a spirit of cooperation among the laborers in the various guilds.

The first tier of foundation stones was laid by the breeder. As was to have been expected, the empiricism of a practical art led the judicial classification and the inductive reasoning of science. One has only to study the wonderful domestic animals in the paintings and reliefs of Babylonia, of Assyria, of Egypt, to realize that knowledge of the effects of selection has been extant for at least six thousand years, perhaps for ten or twenty thousand years. And Jacob's little scheme to mulct his father-in-law of the ring-straked and spotted cattle shows us somewhat of the older theoretical beliefs. Jacob, in fact, seems to have been as advanced a geneticist as many of the animal breeders of the nineteenth century; since the textbooks of this period express a similar belief in maternal impressions and other fables, and contain not a single conclusion that one can now point out as having a permanent value.

Generally speaking, the history of plant breeding gives a little more cause for pride. True, the early Semitic knowledge of plant sexuality was actually lost until the latter part of the seventeenth century; but having rediscovered this fundamental truth through the work of Camerarius, the eighteenth and nineteenth century

hybridizers did leave behind them several legacies well worth while. Kölreuter established the fact that reciprocal crosses give very similar results. A little later the efforts of such men as Sageret, Wiegmann, Gärtner, and Naudin, placed three other conclusions on a firm foundation of experiment; the variability of hybrids of the second generation when compared with those of the first, the dominance of certain individual characteristics, and the occasional reappearance of the qualities lost to sight. Possibly analogous observations had been made previously by animal breeders; but it is certainly within the truth to say that even at the beginning of the twentieth century these were not accepted with anything like the unanimity which existed in the botanical field.

Morphology, with a much later start, got down to essentials a great deal more quickly than experimental breeding. Indeed morphologists built so rapidly during the Victorian era they nearly reached a pinnacle of success that would have given us a different day to celebrate. They lacked but the inspiration to put their "ifs" to the test of calm experiment.

THE CHROMOSOMES

Logically it followed from the theory of genetic continuity by cell division that a material substance passed from cell to cell is the basis of all heredity. Naturally, then, the mechanics of cell division was the subject of intense investigation. The result was the discovery that in building up the tissues of the individual organism, in the preparation of the reproductive cells for their special work, and in the behavior of these cells in carrying out that work, there was an essential similarity of the two processes in both animals and plants.

As these studies progressed it became apparent that the cell nucleus was the controlling agent of inheritance, and that within the nucleus the chromosomes played the star rôle. This hypothesis, put forth as a speculation by Haeckel in 1866, within fifteen years gained the support of such eminent investigators as Hertwig, Strasburger and Van Beneden, largely because of the similar elaborate preparations within the nucleus of egg and of sperm during maturation and of their apparently identical contribution of nuclear material in bi-parental inheritance. Numerous investigations on artificial fertilization were made by adherents and opponents of this view; but owing to the experimental difficulties involved, they were not conclusive. Polemic dissertations on the part played by nucleus and cytoplasm followed that were reminiscent of discussions in he realm of religion or of politics. Gradually the proponents of the view gained more and more converts, not because they were able to demonstrate a monopoly of directive action by the nucleus in development and heredity, not because they could prove the intricate organization of so many unfertilized eggs was controlled by nuclear behavior, for such was not the case: it came through small increments to cytological knowledge which gradually wove a mesh so fine that there was no loophole of escape from the conclusion. Belief in the importance of the chromosomes grew, as in the case of organic evolution, not because of direct proof, but because of circumstantial evidence. Without going into an extended argument on the subject, one may recall the constancy of chromosome number in each species, their individuality in size and shape, the exactitude of their division during growth, and their peculiar behavior at the maturation of the germ cells.

NINETEENTH CENTURY THEORIES OF HEREDITY

These facts, together with numerous minor discoveries, were the basis of nineteenth century theories of heredity. But besides the efforts of the practical breeders and of the morphologists, a serious attempt was made by Francis Galton and Karl Pearson to put genetic studies on a firm groundwork of quantitative experiment. Es-

sentially their method was to measure the degree of association between parents and offspring for any particular character. It was wholly a group method, and by its very nature precluded both the analysis of individual cases and the utilization of biological facts among the premises. Its chief generalization, the law of ancestral heredity, wherein the correlation of characters among blood relatives was interpreted as showing the inheritance of an individual to be made up of a series of contributions, one-half from the parents, one-fourth from the grandparents, and so on, has been shown to be erroneous. Having proved no stimulant to productive investigation, its discussion has passed from the genetic literature of today; but the mathematical procedure evolved by the Galtonian school has proved to be extremely helpful.

The earlier genetic theories of the period under consideration necessarily were highly speculative because of the paucity of known facts; but the fundamental postulate of each, active ultramicroscopic living units, has been retained in the genetic theory of today.

Darwin's provisional hypothesis of pangenesis (1868), for example, assumed that such particles, the gemmules, were given off at all times by every cell, and passed to all parts of the body including the germ cells. He thus accounted vaguely for the inheritance of acquired characters and for regeneration of parts, as well as for ordinary heredity.

Among several contemporary modifications of this type of theory was that of De Vries (1889), who assumed that the corpuscles, which he called pangens, represented potential elementary body characters rather than cell qualities, and that the universe of their activity was the cell rather than the body.

It is clear, even with only a glimpse of such theories, that they could satisfy none but the philosophically inclined. They did little or nothing toward stimulating work designed to test the points involved.

A different fate met the speculations of Nägeli (1884). Here was postulated two types of protoplasm built up of physiological units, the micellæ: the one was nutritive in its functions, and required no particular architecture; the other, the idioplasm, a structure of elaborate constitution, was built of units which represented the potential elementary characters of the organism.

WEISMANN'S THEORY

Utilizing this conception, Weismann (1892) evolved a theory which more nearly fulfilled the requirements of an experimental working hypothesis than any of those previously outlined. The idioplasm or germplasm he identified with the chromatin of the nucleus. His ultimate physiological unit, the biophore, was the biological atom active in building up organic characters. Grouped together into higher units, the determinants, these corpuscles controlled the specialization of cells. The various determinants of an organism made up the *ids* contributed by past generations. The *ids*, if more than one, might differ slightly among themselves, thus governing variation within the species. They formed the chromosomes, or *idants*, by arrangement in a linear series.

Denying the inheritance of acquired characters, and doing much toward demolishing the fallacious logic put forth as proof at that time by adherents in the belief, Weismann outlined a very stimulating conception of heredity on this basis. The immortal germplasm was assumed to be set apart at a very early cell division and passed along unchanged to the next generation, except as the activities of the living units produced occasional changes in its constitution. A provision for accurate equational division of the chromosomes and their reduction in number at the maturation of the germ cells was thus demanded, predicted and afterwards realized—though not precisely in the way he supposed—by discoveries in the field of cytology.

Weismann further accounted for evolution by a selective struggle be-

tween the determinants of the germ cells, and for individual development by a qualitative distribution of the determinants of those cells set apart to build up the bodies which were to act as hostelries for the immortal germplasm.

With Weismann is reached the peak of genetic generalization at the beginning of the twentieth century. Today we have parted company with him in many particulars, nevertheless if modern genetic theory can be said to be the outgrowth of any earlier school, the Weismannian school must be given the preference. As Wilson has said, he brought "the cell theory and the evolution theory into organic connection." His work, besides dispelling many old wives' notions by its cutting logic, was second only to that of Mendel in making genetics an experimental science. Morgan credits him with "the basis of our present attempt to explain heredity in terms of the cell" in that he propounded three of the principles upon which the modern Chromosome Theory is founded.

WEISMANN AND MENDEL

Some may see an inconsistency in ascribing the ground-work of current ideas of heredity to Weismann, and yet celebrating the rediscovery of Mendel's papers as the true break between the old and the new. The obvious reply would be that it takes more than three foundation stones to prop up a useful structure, and that Mendel furnished several examples, most beautifully cut and polished. But there is a deeper truth than this to be emphasized. Weismann unquestionably had a breadth of mental vision far exceeding that of Mendel. He was a real clairvoyant of science, too, and not a mere visionary in the cynical modern sense of the word. Nor was he above the drudgery of experiment. But he failed to have the good luck of initiating a simple method whereby the elementary quantitative relationship between hereditary phenomena could be tested and retested by those who followed him. This fortune fell to Mendel, who, though in a comparative sense a narrow man, was yet able to grasp somewhat of the significance of the results obtained, and leave an imperishable monument to his name. No one may say he was the greater man, but no one can deny he left the most useful work. His results are a satisfaction to the rank and file of scientists for just this reason. They leave a ray of hope to the plodders with whom most of us trail.

The path opened up by Mendel has joined with the path cleared by morphology to produce a road that has extended some distance during the past two decades; but to point out the cairns and avoid falling into the pits is not an easy task. The roadmakers have been numerous, and in general, honestly constructive; but in order to hold this article within reasonable limits I shall mention few names except to pay a just tribute to Morgan as the master craftsman. Nor shall I speak of the attempts at sabotage, except to say they have become more and more infrequent. I shall merely endeavor to recapitulate the fundamental points as best I may with the hope that the effort will not be far afield. At the risk of becoming wearisome I want to try to estimate the progress in terms of general conclusions rather than to describe a heterogeneous selection of ancient heredity puzzles that have yielded to simple interpretations.

GENETICS AND EVOLUTION

First, it must be emphasized that though modern genetics has brought about a clearer orientation of the problems of development and of evolution, it has been concerned directly with the mechanism of heredity. Least progress has been made in connection with the problems of ontogeny. But the conception of where the one ends and the other begins, in so far as this is possible, has become much more definite—at least in this country. It is probable that the interesting phenomena recently described by Mr. Bateson where seeds from various parts of the same plant apparently

transmit different characters, would be less likely to appear so puzzling if this were clearly recognized. And even if we admit our inability at present to contribute much toward the solution of the question, so well delimited by Weismann, of somatic specialization during the development of the individual, one cannot but feel that further progress in dealing with problems of straight heredity will ultimately be helpful.

As to the grand problem of evolution, I believe there has been a concrete offering. True, the question of "how" is still in *statu quo;* but one must be rather a pessimist if he does not consider that the current conception of the gene presents something tangible on the subject. It certainly allows a definite distinction between variations due to environmental fluctuations, variations due to rearrangements and combinations of genes, and variations due to change in the constitution of the unit of heredity itself. Furthermore the data now being gathered on the type of gene changes occurring, and on the frequency with which they take place, are not to be cast aside as of no value to the evolutionist. A statement as to just what they mean would be a daring assertion, but that they mean something now and will mean more later cannot be doubted.

Let us take, for example, the following illustrations, which, I think, are fair.

1. Mutations (Gene variations) are now occurring in all species that have been investigated intensively.
2. There is a wide range to mutation frequency in different species.
3. The number of useless or of harmful mutations is *many times the number of useful or of beneficient mutations.*
4. The number of mutations affecting chiefly certain organs or particular tissues greatly exceeds those affecting other parts of the individual.
5. The "conservative" parts as measured by mutation frequency, appear to have slight relation to the "conservative" parts as determined by the circumstantial evidence of the phylogenist. For example, loss of the ligule, a characteristic of the grass family, has been found in a goodly number of the cultivated grasses,—these being the only ones that have been studied very carefully.
6. Mutations are often reversible. Reversibility may not be universal, though the mere fact that it has not been observed in every case proves only that the reaction does not take place in both directions with the same ease.
7. Mutations which from their major effects can be arranged in a graded series,—for example, eye color of *Drosophila melanogaster,*—are found not to have originated in that order. That is to say, such orthogenetic phenomena as have been observed are better interpreted as analogous to chemical phenomena, where tendency to certain reactions is greater than to others, than as "vital force" phenomena.

No one can maintain that these genetic findings compare with the fundamental laws of thermodynamics in elegance and simplicity. No one can say how general they are. But fruit flies and maize, rodents and peas, upon which the observations were largely made, are pretty far apart in the general scheme of things; therefore it would be very odd indeed if they should turn out to be special cases. And to me they are very helpful to a clearer general conception of evolution.

THE MECHANISM OF HEREDITY

Turning now to the mechanism of heredity, let us see what can be said. The main generalization is that there are units of inheritance, the genes, which are constant in the sense that stable chemical compounds are constant; and whose distribution follows the distribution of the chromosomes. In other words, the discoveries of experimental genetics have made it possible to endow the conceptual units of earlier days with particular qualities, just as discoveries in the physical sciences have made it possible to

delimit the characteristics of atoms and molecules. Presumably there may be other types of inheritance, but the only one thus far described is an exclusively maternal inheritance of certain plastid characters. And even in this case, it is not absolutely certain we are not dealing with symbiotic organisms that are transferred from host to host in some such way as the numerous more or less yeast-like forms being daily described in relation to insects and other lower animals. The mere fact that numerous dicotyledons and monocotyledons on the one hand, and mammals, birds, amphibians, reptiles, fishes, arthropods, and molluscs on the other, show essentially identical types of heredity, makes it probable that the generalized mechanism has been discovered. At the same time, though the angiosperms, insects, and mammals thus far studied intensively, distribute their units of heredity with a convincing similarity of detail, it is altogether likely that special cases of peculiar distributions will be found later. And there is every reason to believe that these odd or unique types of inheritance will parallel a specialization in chromosome distribution departing somewhat from the one we have come to look upon as regular.

THE LAWS OF HEREDITY

This regular or common scheme of chromosome distribution in sexual reproduction has been the basis of practically all of our present genetic knowledge. From past experience with it one can pick out the following inductions, each of which has been tested with variable degrees of thoroughness. They are not set down here with the idea they are necessarily more inviolable than the laws of the Medes and Persians, but merely with the annotation that no experimental data have thus far overstepped them except those on the plastids. They may be called Provisional Laws of Heredity.

The first five of these generalizations describe the mechanism of heredity in the preparation of the germ cells for fertilization.

1. *There is segregation of paternal genes from maternal genes, each unchanged by the association.* The pedigree culture evidence supplements the cytological evidence in favour of the idea that this segregation takes place at the reduction division of the chromosomes in the maturation of the germ cells, when homologous paternal and maternal genes pair and separate, one of each pair passing to each of the two daughter cells.

2. *There may be any combination of the choice of one out of each pair of genes in making up the genetic constitution of the gametes.*

3. *In transmission to the two daughter cells, certain sets of genes are always manipulated independently of all other genes.* This is a statement of independent inheritance, or rather of independent genetic recombination, without reference to the chromosomes. It is an unworthy piece of quibbling, however, not to accept the simple indication of cytology that this law is the result of the operation of the chromosomes acting as gene carriers. It results from the fact that No. 1 pair of chromosomes, no matter how it may be packed with genes, carts its cargo independently of all other pairs.

4. *The manipulation of genes within a given series is always dependent.* This is the phenomenon of linkage, or association in inheritance. Concretely, we assume that the genes packed within each freight carrier pair, an homologous pair of chromosomes, are mutually dependent to various degrees in their recombinations with each other.

5. *The number of dependent series, or linkage groups is limited.* In the fruit fly, the number corresponds to the number of chromosomes, and the presumption is that this is the case in every species.

Added to these five laws are four more generalizations which refer particularly to the architecture of the germ plasm within the carrier.

6. *There is a stable orderly arrangement of genes.*

7. *This arrangement is linear.* The genes appear to be strung together much as a string of magnetized steel balls.

8. *Rearrangement of genes after linkage breaks is stable, orderly and linear.* By this it is meant to say that rearrangement of the package after interchange of the contents of a pair of carriers is also constant and of the same linear order as in No. 6 and No. 7.

9. *A regularity of behavior has been found in the interference of one crossover or linkage break, with a second crossover in the same carrier, which says that the percent of crossovers varies independently of the per cent of interference.* The converse is also true.

There is a fascination to this picture of germplasm architecture, and the type of investigation which has led to these statements will undoubtedly lead to still greater things in the future; but we should do well to realize that each of these generalizations, except probably the sixth, may be a special case; and that new and different special cases may be found without necessitating a change in the first five conclusions.

There is just one other generalization to be mentioned. It is the only one concerned with fertilization, and upon its truth has depended the discovery of all the others.

10. *There is no selective fertilization between complementary, compatible, functional gametes.*

In other words, if a series of male gametes meets a series of female gametes sufficiently alike to be compatible with them, fertilization takes place by chance. Clearly chaos would result if this were not so. Gametes produced by a single hermaphroditic organism may present hundreds of hereditary differences. The slightest tendency to selective fertilization, therefore, would prevent genetic analysis of the results. Happily, this is not the case. Even in the flowering plants where varying lengths of pistil tissue must be traversed by the male gametophyte before fertilization is possible, proof has been offered that rapidity of passage is not affected by differences in gametic constitution. Genes evidently do not begin to function as such until the life cycle of the new generation commences.

OTHER FACTS OF HEREDITY

There are other categories of facts, several of them probably not flowing out of the above conclusions, that are as interesting to the general biologist as the abstract laws. Without them he cannot get a just idea of the actual concrete working out of the heredity mechanism.

First let us speak of dominance. Dominance was originally defined as an observational phenomenon, the appearance of the effect of one of a pair of different homologous genes, as opposed to the disappearance or exclusion of the effect of the other. Later, it was taken to be the presence of an effect as the antithesis of its absence; and this idea was carried to such lengths that many geneticists came to believe that dominance of "A" over "a" was due to actual absence of any function of "a," or even to the physical absence of any gene whatsoever. Now we have come to see that dominance is a mere arbitrary measurement of the approach of the result "Aa" to that of "AA" or "aa." This has been brought about by finding cases in which the effect "A" or "a" in the haploid condition could be compared with the effects of "AA," or "Aa" and of "aa." These cases make it seem doubtful whether the association of "A" with "a" ever wholly inactivates the latter.

With this conception of the function of the genes in mind it is possible to work out pretty definitely the actual resultant ontogenetic characters after different matings, both with and without linkage, by applying the laws I have just discussed. It is merely a straight mathematical relationship following immediately after acceptance of these basic conclusions. But there are several difficulties involved in identifying the concrete results of breeding with the abstract results of

calculation. Some of these difficulties have been leveled, others are yet to be overcome.

One must realize that each gene has many effects on the organism, some of which are not easily discoverable. The fact that a gene is usually ticketed with a name indicative of its most obvious effect on a particular character, should not mislead us in this regard. Then, too, one must remember that many genes affect each organic character; and that similar characters, characters apparently identical, do not necessarily owe their qualities to the same combination of genes. And, finally, it does not follow from any of the above relations, what will be the result of gene interaction. The action of two or more genes may be necessary to bring about a visible or measurable result, though these genes may be carried along separately generation after generation. The full logic of this fact tears down the veil from many an obscure result; since the difficulty of appreciating the results of selection has been due to the failure to realize how many modifying genes may be carried along which have no chance to produce a measurable effect unless a certain basic gene complex necessary for particular organic expression is also present.

This short sketch will show, I hope, that in the twenty-one years of experimental genetics real progress has been made. To be sure, this résumé has been a leaping from crag to crag. No more was possible within the editorial limits here allotted. But if one recalls the scorn of fifty years ago should a daring seer have predicted such a triumph for quantitative mechanical analysis in a subject so overstrewn with variable factors, he in turn will scorn the Freudian over-compensation of today's critic who makes the taunt that it shall go no further.

A Clearer Understanding of Applied Eugenics Necessary

"We believe that a clear view of the underlying biologic facts will greatly help us to a more comprehensive understanding of the surface problems of an economic and political nature."

"If we can do something immediately and directly to advance the health and vigor of the American people; if we can set in motion influences which will certainly improve both the quantity and quality of the next generation; if we can do something to lessen the flood of inferior immigrant stock, which deteriorates our national worth—if we can do only a little to realize some of the hopes of better things—then we will also have done much to improve our industrial situation and to better our social and economic status. Our social questions are not going to be finally settled by a generation that refuses to study and know the laws of human heredity, and which closes its eyes to the scientific principles of race betterment and national uplift."—Wm. S. Sadler, M.D.

DR. FENZI'S CONTRIBUTIONS TO AMERICAN HORTI-CULTURE[1]

THE WORK OF A PIONEER PLANTSMAN IN CALIFORNIA

Wilson Popenoe

U. S. Department of Agriculture, Washington, D. C.

THOSE who have followed the course of plant introduction in the United States during the last quarter of a century have had occasion to become familiar with the work of Dr. E. O. Fenzi, who devoted many years of unselfish effort to securing new economic and ornamental species from all parts of the world and establishing them in California. His introductions are more numerous than those of any other one man, and many of them are now widely grown in the land of their adoption. It seems eminently fitting, therefore, that Doctor Fenzi should have been awarded the third Frank N. Meyer Medal by the American Genetic Association. Those of us who know him feel that this recognition is timely, for his work in our country is ended, and he has, at an advanced age, returned to his native land, Italy, there to undertake a similar enterprise in the new colony of Libya. It is characteristic of the man and his inexhaustible enthusiasm that he should forsake the comforts of civilization at an age of seventy-five years and advance to the very frontier, facing an enterprise which could well stagger a man of thirty.

It is with peculiar pleasure that I recall my first visit to Doctor Fenzi's home at Santa Barbara. As a mere lad, and with nothing to recommend me save an enthusiastic interest in rare plants, I ascended the slopes of Mission Ridge, feeling considerably in awe of the man I was about to meet, for we of California looked to Doctor Franceschi (as he was known to us in that state) as our foremost authority on rare plants. Montarioso, as he called his last home in Santa Barbara, is perched high above the city on a ridge which was devoid of other than native vegetation, save for a few recently planted trees and shrubs. The house, distinctly Italian in design, was visible from all parts of the city, and people marveled at Doctor Fenzi's courage in undertaking to live in so barren a spot. Very little water was available on the ridge at that time, but today the section has been opened for settlement and forms one of the most attractive suburbs of Santa Barbara.

Well do I recall the welcome I received from Doctor Fenzi and his family. It was enough that I should be interested in rare plants; nothing further was necessary to assure me a cordial reception. At the rear of the living room the Doctor had a small study in which were piled European horticultural and botanical journals and many books in French and Italian. The exotic atmosphere of the place made a lasting impression upon me—an impression heightened by the Italian dinner which was served, and by the Doctor himself. His costume was strikingly foreign; a small tam-o'-shanter tilted on one side of his head, a peculiar European jacket of a kind that I had never seen before, and baggy trousers of thin material.

[1] Dr. E. O. Fenzi, of Florence, Italy was awarded the third Meyer Memorial Medal by the Council of the American Genetic Association. The American Minister at Rome presented the medal to Dr. Fenzi in August, 1922.

DR. E. O. FENZI

The same pioneer spirit that animated Frank Meyer in his plant explorations in China is shown by Dr. Fenzi in retiring from an important position with the Italian government in Libya, Italy's North African Colony, and in his 77th year starting a plant introduction station of his own there. Dr. Fenzi has had an eventful life, and in addition to his activities as a plantsman he was instrumental in establishing the first electric car line in Italy.

As we rambled over the hills back of his house, I was impressed immediately by two things: first, the extraordinary courage of the man in coming to this dry and forbidding spot and attempting to grow upon it delicate tropical plants which require vastly more moisture than could easily be supplied them; secondly, the huge fund of information which he possessed on the plant life of all the world.

BIOGRAPHICAL OUTLINE

Doctor Fenzi was born in Florence, Italy, March 12, 1843. He studied at the University of Pisa where he received the degree of Doctor of Laws. Even as a youth he was greatly interested in plant life, but the business interests of the family kept him from indulging his tastes along these lines except in an amateur fashion. After leaving the University he was instrumental in establishing the first electric car line in Italy. At his country place near Florence he formed an arboretum containing many rare trees which are to be seen at the present day. He also did a great deal for the betterment of olive and grape culture in Italy, and on an estate near Rome belonging to one of his relatives he brought together from all parts of the world a large collection of rare plants. At different times he contributed horticultural and botanical articles to the Italian press.

In 1893 Doctor Fenzi removed to California with his family. In Los Angeles he met the late J. C. Harvey, one of the pioneer horticulturists of California; the elder Mr. Howard; Edmund D. Sturtevant; and other plantsmen. A year after his arrival he moved to Santa Barbara, where he entered into partnership with C. F. Eaton for the purpose of raising nursery stock, especially ornamental palms. After a short period the partnership was terminated, and Doctor Fenzi (who was, as above mentioned, known in California as Dr. F. Franceschi) developed a nursery business of his own. He built up an extensive correspondence with botanic gardens, horticulturists, and plantsmen in all parts of the world and received from them seeds and cuttings of all sorts. In 1895 he published his "Santa Barbara Exotic Flora," a small volume in which were described briefly the exotic plants then growing in Santa Barbara gardens. This book remains to the present day one of the most interesting and valuable on the subject of California horticulture. Later he organized the Southern California Acclimatizing Association, which was dissolved in 1909. One year previous to the breaking up of this organization, he published a catalog which contains the most extensive series of new plants which has ever been offered in California.

The cost of bringing in plants from all over the world and the limited demand for this sort of material made financial disaster inevitable. During his twenty years' residence in California, Doctor Fenzi invested thousands of dollars of his own money in this altruistic work. His contribution to California horticulture, therefore, was not alone one of patient and intelligent effort, but also involved a great financial sacrifice.

In July, 1913, he returned to his native land, taking with him his wife and daughter, but leaving two sons in California. He had not been home for twenty years and there were grandchildren awaiting him as well as many old friends whom he wished to see once more. His return was, therefore, an extremely pleasant one, though his departure from California left the plantsmen of that state without their master. He has been greatly missed by all who were accustomed to see him at the various flower shows which he frequented and to receive inspiration from his enthusiastic and untiring devotion to horticulture.

DR. FENZI'S WORK IN LIBYA

After living for two years in seclusion in the Riviera and preparing the manuscript of a book entitled "Frutti

DR. FENZI'S HOME IN CALIFORNIA

Dr. Fenzi's pioneer spirit is further shown in his choice of a site for his home on a stony ridge high above the city of Santa Barbara. When he selected this situation very little water was available, and the ground was nearly barren of vegetation. The region has now been opened up for settlement, and is one of the most attractive suburbs of Santa Barbara, but the wealth of exotic plants on Dr. Fenzi's grounds are a tribute not alone to his success as an introducer of foreign plants, but to his skill and perseverence as a horticulturist as well.

Tropicali e Semitropicali,"[2] he joined his nephew, Guido Corsini,[3] in a trip of reconnaissance to the recently acquired colony of Libya. Shortly afterwards he accepted an appointment as head of an institution established by the Italian Government to undertake the introduction into Libya of new agricultural and horticultural plants and the development of agriculture in that colony. For several years he held this post and then retired to carry on the same work at his own expense. He has accomplished much in the few years which have passed since his arrival in Tripoli. Several species of Eucalyptus have been successfully established, as well as numerous fruit trees and vegetables. In his last letter to us, dated August 29, 1922, he reports excellent results with pistache and carob trees budded last winter, and asks for seeds and cuttings of a number of plants which he desires to test. Though now an old man in years, his spirit is undaunted and his letters show the same enthusiastic and active interest in new plants which made his presence in California an inspiration to all who knew him there.

Doctor Fenzi has the satisfaction of knowing that California gardens will be more beautiful for all time, and California orchards will contain a greater number of delicious fruits because of his sojourn at Santa Barbara. He also has the satisfaction of knowing that he has left many friends in this country—not alone in California—who appreciate his work and who are deeply grateful for his untiring and unselfish efforts to enrich the land of his adoption.

HIS PLANT INTRODUCTIONS

Below are brief historical notes concerning some of Doctor Fenzi's more important introductions. I will not attempt to mention all of the plants which he had the honor of establishing in California; there are too many of them to be discussed here, and regarding several there is some doubt as to the exact time of their introduction. The following notes are substantially as given me by Doctor Fenzi in 1911, and published in "The Florists' Exchange" for February 10, 1912:

Lippia repens.—This remarkable substitute for lawn grass will grow on almost any soil, and requires very little water. Originally secured in 1898 from the Botanic Garden at Rome, it has spread all over the southwestern states and now covers thousands of acres. It withstands extremes of temperature, and is much used on sloping ground to prevent erosion by the heavy rains of winter. It is particularly valuable because, unlike Bermuda and several other grasses used for lawns, it does not have underground rhizomes, and is consequently easily exterminated when desired.

Feijoa sellowiana.—This promises to become one of the most valuable of Doctor Fenzi's numerous introductions. It was obtained from France in 1901, after having been established in that country by Edouard André. The Feijoa is a close relative of the guavas, but considerably hardier than any of them and of greater value. The fruits are about the size of a hen's egg, green in color, and of a most delicious pineapple flavor.

Vitis capensis.—Some forty years ago, when the phylloxera threatened the vineyards of France with total destruction, energetic efforts were made to procure from every country grapes which might prove immune to this disease. Much hope was placed on the tuberous-rooted kinds from Africa, among them *Vitis capensis*, occasionally found in European botanic gardens, where it had been known since the end of the eighteenth century. In

[2] Published by the Instituto Agricolo Coloniale at Florence, 1915.

[3] During the last years of Dr. Fenzi's work at Santa Barbara, Guido Corsini spent much time with him, and became extremely popular in Santa Barbara. He was a young chap of excellent breeding, and the most democratic manners imaginable. One of his Santa Barbara friends visited Florence a few years ago, and was impelled to hunt up Guido. He was directed to a marble palace, and when he inquired somewhat timidly at the door if Guido Corsini was at home, a liveried servant replied, "No, the marquis is not in just now."

a few years' time it was shown, however, that only some of the North American grapes and hybrids derived from them were phylloxera resistant, and the African species fell once more into oblivion. About 1900 Doctor Fenzi happened to obtain seeds of *Vitis capensis* from one of the botanic gardens in Holland, and the few plants raised were used for hanging baskets. It was soon discovered that they produced tubers abundantly and that the vines made very luxuriant growth. This plant has now become popular in California under the name of "Evergreen Grapevine," and is unexcelled for pergolas and arbors. The glossy green leaves are persistent throughout the year, and the dark purple berries can be used for making jellies and preserves.

Buddleia madagascariensis.—For scrambling over boulders and stone walls, this vine has proved to be excellently adapted. Many years before he left Italy, Doctor Fenzi had admired the species on a sea wall at Posilipo, near Naples. During his first year in California he sent over for seeds, which were finally received and planted, but failed to germinate. The second year he tried again, and succeeded in obtaining young seedlings, all of which died within a short time. The third year seed was again procured, and two dozen plants were successfully raised.

Lyonothamnus floribundus var. *asplenifolius.*—This is the beautiful fern-leaved Ironwood or *Palo fierro*, which grows only on the islands of Santa Cruz and Santa Rosa, off the coast of California. It had been known to botanists for a short time, but had never been introduced on the mainland, when, in November, 1894, Doctor Fenzi spent a week on Santa Cruz Island, and after trying in vain to find small seedlings, he decided to dig an old stump and take it home to his garden. Being alone, and with no tools but a small pick and a pocket saw, it took three hours to do this, and then it had to be carried a mile to the beach. It was so heavy that Doctor Fenzi had to stop and rest every fifty steps over the entire distance. But finally it was brought home, and planted in the lath house at Montecito. In five or six months it began to sprout, and when a year later Doctor Fenzi moved to Santa Barbara it was transplanted to his new place, where it is still growing, and blooms and seeds with each returning year.

Taxodium mucronatum —This is the Montezuma or Chapultepec Cypress, a majestic tree famed in the history of the conquest of Mexico, and closely related to our redwoods or Sequoias and to the Bald Cypress of the Gulf States. Doctor Fenzi had many times admired the specimen planted by Tenore, who originally described the species, in the Botanic Garden at Naples. Seeds were obtained from there and elsewhere, year after year, but they always failed to germinate. Finally, after ten years of unsuccessful effort he obtained from the Federal Park at Chapultepec, Mexico, seeds which germinated, and from which were raised the fine specimens now so greatly admired at Santa Barbara and elsewhere in California.

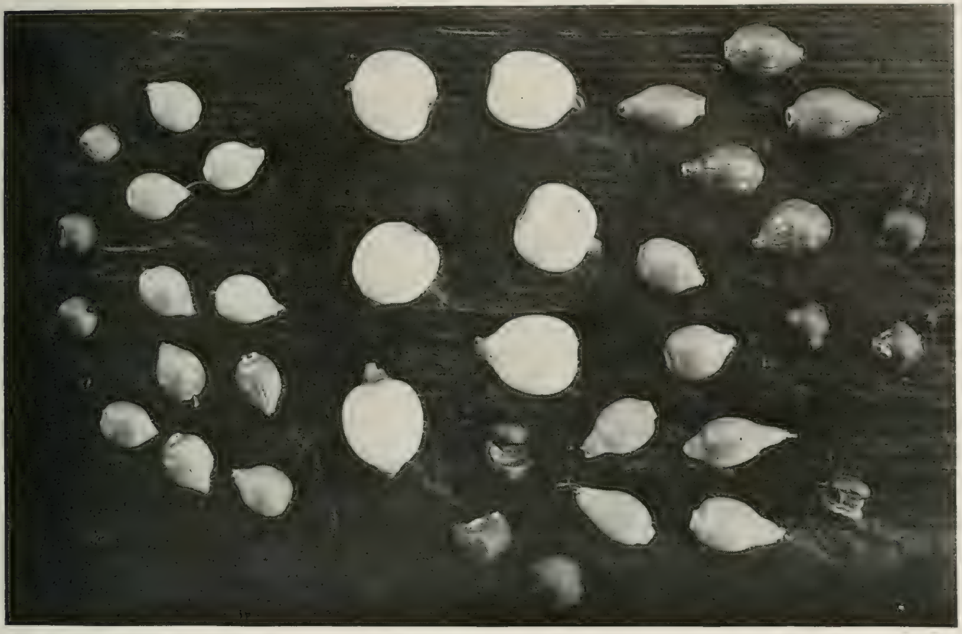
Asparagus scandens var. *deflexus.*—In 1897 seeds of this species were received from the Botanic Garden at Cambridge, England. From them were obtained the first plants ever raised in this country. It did not take long for the merits of the plant to become appreciated, for it is much finer and more graceful than *Asparagus sprengeri*. By many people it unfortunately became confused with *Asparagus decumbens*, through the sim larity of the names.

Acacia podalyriaefolia.—In the year 1900, Doctor Fenzi received seeds of this species from Australia, and succeeded in raising two or three dozen plants, which seemed to be more difficult to handle than other species of Acacia. Three of these eventually became good sized trees—one at Redlands, one at Pomona, and one near Pasadena. Since they commenced to bloom, much attention has been attracted to the species, which is one of the most beautiful of the Acacias.

ADLAY—A NEW GRAIN PLANT FROM THE ORIENT

A Relative of Indian Corn Found in Eastern Asia in a Great Number of Varietal Forms—Offering an Untouched Field of Work for the Plant Breeder

P. J. Wester
Bureau of Agriculture, Philippine Islands



"JOB'S TEARS"

Figure 8. *Adlay* is the native Philippine name for the plant known to us as the source of "Job's tears." Only the hard-shelled beadlike forms are grown in this country and Europe as an ornamental novelty. Some of the grain varieties of *adlay* that grow in the Philippines have a soft hull that can easily be broken between the fingers. Like its American relative, Indian corn, *adlay* lacks gluten, but is richer in fat than either corn or rice, making it a better balanced food than any other tropical grain crop.

WHEAT, rice, corn, rye, oats, and barley are the six staple grains which enter into the international commerce of the world. Next follow the sorghum grains, locally of great importance in Africa, India, and China, and the *ragi*, (*Eleusine coracana*), extensively grown in India. The various small-grained millets are relatively unimportant as foods except in circumscribed areas. This is true also of the grain form of *Coix lachryma-jobi* L., for which the Philippine name *adlay*[1] has been adopted for common usage in place of the cumbersome English name, "Job's tears."

Though it was known to the writer that this grain was eaten by certain primitive people in the Philippines and India, on coming across a few plants growing in a little village in the interior of the Island of Mindanao in the Philip-

[1] Adlay should be pronounced ad' ly (*a* of the second syllable silent and *y* as in "my.") Accent on the first syllable.

ADLAY PLANTS

FIGURE 9. We are accustomed to think of the "Job's tears" plant as being of dwarf habit, but in the Philippines it often grows seven or eight feet tall. In addition to its dietetic advantage over rice, adlay offers the further advantage of growing on dry land, thus doing away with working in marshy *paddies*. The crop can be cultivated and harvested by machinery while the work on the rice fields must be done by hand.

WHERE ADLAY GROWS

FIGURE 10. In the interior of the Philippines a few isolated tribes were found to be using "Job's tears" as a grain crop. Seed from these native fields was grown near Manila and a remarkable yield was obtained, in some cases more than 3,625 kilos to the hectare (3,230 lbs. to the acre). Adlay is also grown as a grain crop in Java and India, and the Dutch had experimented somewhat with it in their East Indian possessions, although this was not known when these studies were undertaken in the Philippines.

pines, in August, 1917, it first occurred to him that adlay might have possibilities as a grain for general culture.

The vigor of the plants and the great number of seeds borne on each was so noticeable that arrangements were made for having a quantity of the grain, when mature, sent to Zamboanga for experimental purposes. This arrived in due time. Some was planted and some sent to the Bureau of Science in Manila for analysis.

The hulled grain analyzed approximately like wheat and the experimental plot yielded at the rate of 3625 kilos of grain to the hectare (or 3230 pounds to the acre). Interest in the plant and its possibilities grew and the experiments were continued in 1919 at the Lamao Experiment Station. The harvested grain was brought to Manila for milling and, although there were no flour mills available, it was successfully hulled and ground into meal on a coffee mill, the product being reground several times to attain the necessary fineness of the flour.

In the first attempt to use the flour it was mixed with an equal quantity of refined wheat flour and made into biscuits. The quantity of adlay flour was later increased to 66 per cent and, in this proportion, was also tried out for hot cakes. The "cracked" grain was also eaten like oatmeal and similar wheat preparations. These dishes were sampled with no little curiosity, not to say trepidation, in the belief that they were the first attempts so to utilize the grain, for the writer did not then know that the Dutch had already tried it out in these various ways. It was found that the coarsely ground grain could be used as a breakfast cereal and that the meal or flour, mixed with not less than one third wheat flour, gave very satisfactory results as a wheat flour substitute.

Sample biscuits were distributed to several persons and finally were served acceptably at a tea given by the Philippine Chamber of Commerce, and then at luncheons given by the American Chamber of Commerce and the Rotary Club, all of Manila.

It was also found that good, though somewhat heavy, yeast bread could be made of a whole adlay flour, mixed

A PHILIPPINE FLOUR MILL

FIGURE 11. The grain is pulverized in the mortar and pestle and then the hulls are sifted out with the sieve shown in the foreground. The adlay flour used in the first bread-making experiments in the Philippines was ground in a coffee mill, but the grain is well adapted for milling with modern machinery.

ADLAY FOR ORNAMENTS

FIGURE 12. Notice the elaborate collar and pendant the man is wearing. The beads in it are made from hard-shelled grains of adlay. The fact that some of the hard-shelled varieties of this species are so well adapted for making beads has resulted in their being widely distributed throughout the tropics, and some temperate countries as well. The hard-shelled beadlike forms have been known to Europeans at least since the time of Pliny, but it is not until the seventeenth century that European writers make any reference to the soft-shelled kinds, although these have been grown in India and China since very ancient times.

A HEAD OF ADLAY

FIGURE 13. Some of the most prolific kinds have very thin hulls, making them desirable as grain varieties. There is great variation in the amount of hull found on the seeds, in some of the hard-shelled varieties it constitutes 74 per cent of the weight of the seed, in others only 23 per cent. These figures are for unimproved varieties, and by the application of modern methods of hybridization and selection the percentage of hull should be greatly reduced.

with from 33 to 50 per cent wheat flour; and a "pumpernickel" of good flavor, though too heavy to gain general acceptance, was made with an 80 per cent adlay flour mixture.

DESCRIPTION OF PLANT

The adlay plant is a coarse annual grass, 2.5 meters high, monœcious like its well-known relative, maize. The ordinary wild form has hard, beadlike, shiny seeds for which it is cultivated as an ornamental in the United States and Europe. The hard shell or hull which in some varieties constitutes 74 per cent of the fruit makes these practically valueless as grain. In the varieties raised for grain, the hull is so thin and soft that in the most desirable kinds it may be broken by a slight pressure of the finger. In different types the hull has been found to range between 23.4 to 47.76 per cent of the total weight of the grain.

There are many different varieties of adlay, more especially in Burma, varying both in appearance of the plant and the grain, and in the analysis of the latter. In the Philippines seven distinct kinds are known at present, some of which are shown in Fig. 8. In color the dried grains run from a chalky white through various shades of creamy yellow, gray, and brown to almost black. In shape they are spherical to oblong almost like a plump oat grain. There is also great variation in the size of the grains. In some varieties, they are not more than 6 mm. long, with as many as 15,500 grains to the kilo, while in others they are more than 10 mm. long, and less than 3,500 grains to the kilo. In the most desirable small-grained types one hectoliter weighs from 46 to 60 kilos.

The wild form with hard, beadlike seeds was known to Pliny, but the soft-hulled grain form does not appear to have been known to European writers until the seventeenth century, though in India it was undoubtedly cultivated in very ancient times.

ECONOMIC IMPORTANCE OF ADLAY

The yields obtained from field experiments have been remarkably high, varying from 1,634 to 3,625 kilos to the hectare. The average yield per hectare in six trials in widely separated regions in the Philippines, and the Dutch East Indies, was a trifle more than 2,900 kilos. Allowing for errors, due to small areas, it seems safe to calculate an average yield of 2,000 to

2,500 kilos of grain to the hectare. Eighteen bushels of wheat per acre is equivalent to 1,225 kilos per hectare.

The figures given are for the yield of unimproved varieties of adlay. Much larger harvests may be expected from the application of systematic breeding such as has been used with other cereals. An increase of from ten to fifteen per cent is not an unreasonable expectation.

It appears from an analysis made by Dr. A. W. Wells, Chief of the Division of Chemistry and Mr. F. Agcaoili, Chief of the Section of Food Analysis, Bureau of Science, Manila, that the hulled grain of adlay approximates wheat in composition, but with greater fat content, and that it is a far better balanced food than rice or corn, the two great staple grains of the tropics.

The one great difficulty of the adlay grain is the lack of moist gluten. This difficulty is overcome by adding wheat flour in the proportions already mentioned for making bread and biscuits. In composition this bread is, for all practical purposes, equivalent to wheat bread.

In a more detailed discussion of adlay in a recent issue of the *Philippine Agricultural Review*, it was pointed out that this grain may be grown wherever rice is cultivated. Where the growing wet season is followed by a dry period it is more productive than rice and it should be possible to grow and harvest adlay with machinery like that used for wheat. This makes its cultivation easier than that of rice, which must be grown in paddies and since the preparation of rice paddies and the transplantation of the rice plants is the hardest and most disagreeable of farm occupations, the culture of adlay would have many advantages. It would appear, then, that with lowered production cost and a larger yield of better grain per unit area, adlay is destined to supplant rice as the leading staple grain, not only in the Philippines, but possibly throughout a very large part of the tropics.

POSSIBILITIES OF THE ADLAY

This year (1922) the Bureau of Markets and Crop Estimates, United States Department of Agriculture, conducted a series of milling experiments with adlay shipped from the Philippines and bread making tests with the flour obtained. The milling was done by Mr. James F. Hayes, Milling Technologist, and the baking by Mr. Walter K. Marshall, Acting in Charge, Milling Investigations. Dr. C. F. Langworthy, Chief, Office of Home Economics, Bureau of Plant Industry, arranged for a series of experiments which were made by Dr. Minna C. Denton, Assistant Chief. These culminated in a demonstration adlay luncheon served to the scientific staff of the Department of Agriculture. Their expressions regarding the samples tested which included several kinds of bread, biscuits, cakes, and pies, were unanimously favorable. The following statement by Dr. Walter H. Evans, Chief, Insular Stations, States Relations Service, is typical: "The adlay products were very palatable, and it would seem to me the grain offers great possibilities for the tropics."

Prophecy of Rural Civilization

"The next great social change, as I see it, is decentralization. Electricity made the big city, now it may be expected to unmake it. It was necessary that the city come into existence first. Without cities we have found it impossible heretofore to attain a high degree of human culture. But all the advantages of the city will soon be possible for the farm, without having to put up with the unendurable iniquities of city life. Economy, efficiency and culture may soon be broadcast. When they are we won't have to suffer from subway jams, freight congestion, high prices, impossibly high rents for impossibly cramped living quarters, strikes, unemployment, crime waves and a hundred other plagues of modern times.

"Electricity is not only the cleanest and most efficient servant that mankind ever had, but it is also the cheapest. It works for less than a coolie's wage, and its wages are going down every day, while its efficiency is being constantly increased. In addition to this it does its own traveling, at the rate of 186,000 miles a second, and doesn't have to be transported. Heretofore we have been compelling it to take us to the city, and it has done so beautifully, more quickly and comfortably than we have ever been moved about before. Hereafter we shall simply touch a button and have it bring the city out to us.

"We have been mining coal and carrying it across the country to be turned into power. Soon we will be sending the power across the country. If we persist in getting the power from coal, we shall at least burn the coal where it is mined, converting it into electricity, not use up a big portion of the power, as we do today, in the process of transporting it.

"But there is every indication that we shall go much further than that. In the country where our food grows, is the best of all places to eat it. Sending it to the city costs much more than getting it out of the ground, and it has lost a lot of its flavor by the time it has reached the ultimate consumer. Also, there isn't room to live in the city, especially for children. They can't have real homes; they can't stretch and grow, physically and spiritually, as human children should. The city has almost destroyed the home, but it has provided other advantages which the modern man can hardly do without. If only these advantages could be brought to the country village and the farm—well, watch what electricity is going to do next.

"We have learned now that the small industrial unit may be as efficient as the gigantic one, or more so. The next big step in industry, it appears, will be on the development of the small electrically driven factory in the places where the raw materials are found. This will save the transportation of coal and raw materials. It will also do away largely with seasonable employment, for manufacturing and agriculture can arrange winter and summer schedules as conditions demand.

"Cloth will more and more be manufactured where the cotton is grown. The flour mills will leave the cities and go back to the farm. Everybody will be using machinery and learning how to use it and because the population will follow the machinery the country districts will become inhabited again. Work can then be more equitably divided. It won't be necessary to over-work half the year and vegetate the rest. There will be work enough to go round and there will be hands enough to do it, for the country life of the future will not be the dull, forbidding, solitary thing which the concentration of industry has made it now."—Charles A. Coffin, *The Agricultural Review*, Vol. XV, No. 6, p. 5, June 1922.

PRACTICAL TESTS IN KARA-KUL SHEEP BREEDING

C. C. Young
Denver, Colorado

THE Karakul sheep is indigenous to the great Kara-Kum Desert of Central Asia, where this wonderful fur producing ovine competes with the camel, the burro, and the wild goat—the djiran. While one occasionally encounters zebu cattle and Arab horses along the few streams, it cannot be said that there are any other domestic animals in the desert proper except those mentioned above.

The Karakul sheep is a descendant of the extinct Danadar, and the natives have for years killed the lambs possessing the best fur qualities. In spite of this unbusiness-like method a Government bulletin is authority for the statement that we are still paying a tribute of millions of dollars for the Karakul lamb skins that reach here under such trade names as "Persian Lamb," "Astrakhan," "Baby Lamb," "Unborn Lamb," "Broadtail," "Gray Krimmer," etc.

During the past twelve years the author has made three importations of Karakul sheep into this country, and although efforts have been made by several other breeders to accomplish the same purpose, none have been successful.[1]

In 1914 Mr. John Agnew of Prince Edward Island, Canada, made an importation of Karakul sheep from European Russia. These were brought to Newfoundland. In a future article the author expects to give the history of his importations and explain why he did not select his Karakuls in European Russia, preferring to get them from that section of the Kara-Kum desert which extends into Bokhara, southeastern Transcaucasia, and Northern Afghanistan.

The misrepresentations made by certain breeders as to the importation of Karakuls into this country has lead to a great deal of confusion, and it would be a matter of considerable importance to get this matter definitely cleared up.

THE KARAKUL A DESERT SHEEP

Tests made in practically all sections of the United States and Canada have demonstrated that Karakul sheep can easily be acclimated to other than desert conditions, although it must be born in mind that this sheep is essentially a desert animal and able to undergo the great hardships incidental to desert life. A test covering a period of several months, made near El Paso, Texas, proved that Karakul sheep were able to accumulate fat on scanty, dry pasture, as rapidly as Merinos fed on alfalfa and milo maize. When several Karakul lambs were slaughtered after this test they were pronounced too fat by the chef of the Paso del Norte Hotel of El Paso.

The Karakul is able to reach as high as a cow (E. E. Clark, Bureau of Forestry), which enables it to eat the seed-bearing parts of the weeds and brush. It also possesses all the browsing characteristics of the goat, having unusually hard teeth and a very tough mucous membrane of the mouth. These characteristics account for its rapid accumulation of fat when forced to maintain itself on dry feed. The author does not mean to imply that the Karakul sheep refuses to eat the grasses relished by domestic sheep, although it cannot be said that they are as fond of succulent feed as is the case with some of the British breeds, as was proved by Professor Wallace at Edinburgh.

[1] *Yearbook*, United States Department of Agriculture, 1915.

During the entire summer of 1919 a flock of Karakuls was able to thrive on alkali and dry foxtail in the San Joaquin Valley of California, to the great amazement of the sheep raisers of that region, who are forced to remove their sheep by the first of May or suffer great losses.

HARDINESS UNDER OTHER CONDITIONS

During the summer of 1920, the United States Bureau of Forestry conducted a most interesting test, an account of which is contained in the following letter:

Kerman, California,
September 6, 1920.

Mr. M. A. Benedict,
Forest Supervisor,
North Fork, California.

Dear Mr. Benedict:

Referring to your letter of May 11, 1920, in re Karakul Sheep.

On March 20, 1920, Mr. E. E. Clark, of your service, brought to my place, for the purpose of a grazing demonstration, four Karakul rams, the property of the Kerman Karakul Sheep Company. These rams were placed in a twenty-three acre field with about forty hogs, and where there is and has been very little feed on the ground. The hogs I have fed. The rams have been subsisting on the browsing from oak, chapparel, willow, manzanito, sour berry bush, and some little grass, and have not been fed. I know of no other stock that would have survived in that field unless, possibly, goats.

On May 11th I caused these rams to be shorn, and after the clip was taken the rams were weighed, and were again weighed in August with the result as follows:

	May 11, 1920,		Aug. 31st, 1922	
	Weight of Wool	Weight of Clipped Ram	Weight of Ram	Gain
Y 1	10 lbs.	150 lbs.	215 lbs.	65 lbs.
Y 67	8	143	180	37
212	10½	132	173	41
Unmarked	11	103	142	39
Totals	39½ lbs.	528 lbs.	710 lbs.	182 lbs.

This seems to be a remarkable gain in 110 days, considering the poor pasturage.

It will be noticed that the smallest ram, weighing 103 lbs., gave the heaviest clip of wool,—11 lbs. I believe these sheep are well adapted to this brushy country.

Very respectfully,
(Signed) W. M. Sell.

(The above was a six months' clip and being free of fat did not have to be scoured; the loss in Merino wool from this source is about 50%.)

During the summer our entire flock of Karakul sheep was pastured on dry chemiza, sage, and other brush in the valley near San Bernardino, California, where a flock of 1,500 goats was pastured, with a view to ascertaining whether or not the Karakul could compete with the goat. This test, extending over a period of eleven months, was conducted by one of the Los Angeles packers, who was able to satisfy himself of the great hardiness of the Karakul. He has since invested twelve thousand dollars in Karakul sheep, at a time when it was impossible to sell domestic ewes.

QUALITY OF THE MEAT

As far as the mutton qualities of the Karakul are concerned, it can be stated that it does not have its equal in the world, as it is entirely free from the characteristic flavor of the sheep family and tastes more like venison than mutton. The fat of the Karakul sheep is the butter of Central Asia, and can be used for cooking purposes.

USES OF THE WOOL

The wool of the mature sheep is very coarse and forms the basis of all Oriental rugs, such as Bokharas, Khivas, Persians, Afghans, etc. It is ideally adapted for felt, and a great variety of garments are made out of it in Asia, among them being the famous capes, known as "burkas." Wonderful blankets are woven out of this wool by the Navajo Indians, and it should be of particular interest to the countries south of the United States where the

TEDDY

FIGURE 14. One of the best imported rams in this country. The Karakul fur sheep is a native of the Kara-Kum desert of central Asia, which is situated east of the Caspian sea, and north of Afghanistan. This is the region immortalized in Arnold's *Sorab and Rustum*, and it is from Bokhara, just to the east, that the famous "Persian rugs" come. The Karakul sheep is descended from the Danadar, a breed of black fur sheep that became extinct about eighty years ago. The practice of killing the lambs having the most valuable skins has resulted in great deterioration in the fur sheep of this region. (See text, p. 234.)

introduction of fine wool breeds has greatly interfered with the making of the best blankets. Karakul yarn is used for mending Oriental rugs, and is worth between four and five dollars a pound, thousands of pounds being imported annually. With proper grading and marketing precautions Karakul wool should bring as good a price as the wool of certain of our domestic coarse wooled sheep. Karakul wool sold recently for 28 cents, when Shropshire wool was bringing 30 cents. In the Southwest two clippings a year are the rule.

THE FUR

Were it not for the fact that Karakul sheep are fur bearing animals, in addition to being mutton and wool sheep it is doubtful whether the writer would ever have risked an expedition into Central Asia, even though their importation meant the utilization of millions of acres of desert land which today is practically valueless.

Karakul lambs are generally black at birth, with a wonderful luster, and those of superior quality possess tight curls. The skins obtained from such

lambs when not more than three days old have brought an average price of about twelve dollars per skin during the past fifteen years. A remarkable fact is that half-blood lambs, sired by the best Karakul rams, bred to coarse wooled domestic ewes, often produce skins that bring as high a price.

In view of this fact, the natives of Central Asia, who have no conception of selective breeding, have always crossed Karakuls with the many other breeds found in Western Turkestan. A great many of the lambs do not come true to color, and owing to the admixture of fine wool (Afghan fine wool) most of the lambs come with open curls, giving us the so-called "Astrakhan Fur." The author has found in using the best Karakul rams on domestic coarse wooled ewes, that practically 100% of the lambs come black with tight curls, the tightness depending upon the coarseness of the wool and absence of fine underwool in the domestic ewes. Unfortunately in a great many countries Persian lamb fur is confounded with Astrakhan. This is especially true in the Latin American countries, and the difference in price amounts to at least fifty per cent. Upon careful investigation I have found that hundreds of thousands of kid skins are dyed black, and since they possess the required luster, are sold as Astrakhan fur.

AN UNFORTUNATE CONFUSION IN TERMS

It is very confusing that the most *inferior* Karakul lamb skins are termed "Caracul" by furriers, and few furriers know that the Karakul sheep is the only source of the so-called "Persian Lamb Fur." This is *not* the product of the Persian sheep at all, for the Persian is red and possesses no fur qualities whatsoever, unless crossed with Karakuls.

Many kid skins are dyed gray and are sold as "Gray Caracul" and this also applies to those dyed a tan color and sold as "Tan Caracul." It must be said that the American furrier is a master in the art of imitation, but one thing he cannot do and that is imitate the Karakul lamb skin with *tight curls* (Persian Lamb Fur).

For this reason the author has confined all his efforts to the production of Karakul lambs with tight curls. And the breeder who wishes to raise Karakul sheep with a view to getting $12.00 and $15.00 for his lamb skins should purchase only tested rams which will surely give lambs with the desired "Persian lamb" pelts, providing the domestic ewe is free from fine wool and possesses the coarsest of fleece. The coarse wooled ewes best adapted for this purpose are the Navajos, black faced Highlands, the hairy Mexican Corrientee, Cotswold, Lincolns, and the Achuri (Persians).

It makes a great difference to a breeder whether the lamb skins he brings to the furrier are worth twelve dollars apiece, and cannot be imitated, or whether they are of the "Astrakhan" type, indistinguishable from dyed kid skins, often worth only fifty cents.

IMPORTANCE OF HIGH GRADE STOCK

Karakul skins with open curls are more wavy in appearance than kid skins dyed black, and for that reason they bring a higher price, which, however, seldom exceeds four to six dollars per skin. For this reason the author has always urged the beginner to purchase only the best tested rams. He was greatly disappointed two years ago when the Government of Venezuela purchased eight Karakul sheep of the open curled variety, instead of the highest grade rams, for crossing with good, coarse wooled, domestic ewes.

Most breeders buy inferior bucks, since they cost only one-tenth as much as the tested rams which produce salable skins in the first cross with domestic ewes. It is a discouraging fact that they then frequently put forth claims that could only be justified where the most careful selection was practiced. In a very few instances where rams were purchased at a price above $500, and where results could be expected in the first cross, the domestic ewes were not

A KARAKUL LAMB

FIGURE 15. These are the sheep that produce the "Persian lamb" skins so greatly in demand for fur. Persian sheep have no value as fur producers whatsoever, and the use of this term is very misleading. The mistake probably is due to the fact that the trade routes from central Asia to Europe formerly lay through Persia. The same mistake is made in calling Bokhara rugs "Persian rugs"; they were not made in Persia, but simply came through Persia on their way to the markets of Europe. (See text, p. 232.)

properly selected, necessitating two crosses to produce $10.00 skins.

A matter of great importance is the fact that where one raises half-blood lambs for their pelts they have to be killed during the first two or three days, so it is possible to lamb twice annually. This is done in the Southwest and also in Colorado. The author is not in a position to state whether two lambings would be possible in the middle and eastern states, but sees no reason why it should not be.

A LARGE-SCALE EXPERIMENT IN KARAKUL BREEDING

Last year, it was almost impossible to interest any one in sheep of any kind, notwithstanding the fact that Karakul skins were not affected in the general depression and brought a higher price than ever before. Nevertheless, the author was successful in inducing the San Clemente Sheep Company of California, to purchase 1,500 Navajo ewes, which were crossed with his best Karakul rams. Unfortunately the selection of the Navajos was not done with sufficient care, and very few of the ewes possessed the required coarse fleece, practically none of them were free from the objectionable fine under-wool. Most of the lambs came true to color, and possessed a surprising amount of luster, probably due to the great abundance of Australian salt bush, but the curls were not tight enough. We killed seventeen of the lambs when two days old and submitted these skins for pricing to the eminent furrier, Mr. Colburn, of Los Angeles, who has in his employ one

of the best known dyers of Karakul skins in America. His opinion of these skins is given in the following letter:

Los Angeles, California,
April 20, 1922.

Dr. C. C. Young,
Los Angeles, California.
Dear Sir:

With reference to the seventeen half-blood Karakul skins brought to us today to be dressed and dyed, we wish to state that $7.00 would be a conservative average price for these skins.

Considering the fact that they are only half-blood skins makes us realize the great possibilities of your industry.

Wishing you success,

Very truly yours,
COLBURN'S TAXIDERMY STUDIO,
By A. E. PENDL, MGR.

Had the Navajo ewes been properly selected, many of the half-blood skins would have brought $10.00 instead of $7.00. With two lambings yearly one can figure out the great advantage of raising sheep for the production of Persian Lamb. There are no losses as the skins of the dead lambs have the same value as of those killed, and in a large measure that applies to the skins of the slunks, which have been known to be worth as much as $20.00 per skin, and are known in this country under the trade names of "Unborn Lamb," "Baby Lamb," and "Broadtail."

Several Colorado breeders have tried raising Karakul sheep and the results are most gratifying. Some two years ago Mrs. M. J. Hoff procured a small flock of Karakuls and last summer she purchased a very fine Karakul ram having convinced herself that her mountain ranch at Bendemeer is ideally adapted for the raising of Karakul fur. She has invested $65,000 in Karakul sheep, and today is part owner of the flock that includes some of the choicest rams ever raised in this country.

The United States Department of Agriculture states that we require millions of dollars worth of Karakul lamb skins annually, and there is a further demand in Canada. In spite of the war, seven different Governments have reports of tests made during several years with rams furnished by the author. Owing to the high price of the best Karakul rams, Mrs. Hoff proposes to let them out on a division basis of the increase, where breeders possess the required pasture and the necessary coarse wooled ewes.

A HYBRID BREED

The natives of Bokhara, who have had a monopoly on the Karakul industry, cross-breed and in-breed, and have for many years been killing their best lambs on account of the high price commanded by their pelts. It is therefore an extremely difficult matter to obtain any great number of high grade Karakul rams. Out of thirty-one imported bucks only four produced lambs with tight curls. An effort is now being made to breed more high grade rams by employing Karakul ewes not related to our best rams and crossing them to bucks which have been secured from certain flocks that were composed of inferior Karakuls. It appears that occasionally atavism will play pranks in a flock from which one would hardly expect anything but open-curled lambs, on account of the tremendous amount of fine Afghan under-wool. Fortunately, the four good rams above mentioned can hardly be related, for they were selected in various sections of the desert, at a great distance from each other.

The Karakul possesses the blood of every breed of Central Asian sheep, as is proved by the great anatomical differences found. However they only produce offspring with black, lustrous, tight curls when they are free from fine wool admixture, and have enough of the extinct Danadar strain in them. The Danadar, the original black fur sheep of Central Asia, became extinct some eighty years ago, but what little of the strain is left in some of the native sheep of Bokhara has cost us millions of dollars annually. It is very confusing that some of the Russian Agricultural Societies, which imported

A BROADTAIL KARAKUL

FIGURE 16. The Karakul is not a pure breed, in fact only 4 of the 31 imported bucks produced offspring with the desired tight curls. The natives of the Kara-Kum region have no conception of selective breeding, and these sheep are crossed with every breed of central Asia. Note the differences between the lamb shown above and the one shown in Fig. 15. Particularly striking are the differences in their tails, this lamb evidently being partly of broadtail ancestry. Tightness of curl is greatest at birth and begins to become less after two or three days. The time and the extent to which this takes place varies with different animals, and at an age of one month this lamb still has remarkably tight curls. (See text, p. 231.)

a few hundred Karakuls into European Russia, jumped at the conclusion that these sheep were full bloods, and issued certificates to that effect, in the few instances where they sold these sheep. This accounts for the fact that the author considered the first nineteen sheep brought to this country by him in 1908, to be pure blooded Karakuls. At that time it was hard to account for the fact that there was no semblance of anatomical similarity, and great differences in the wool of the sheep.

In 1912, at the Sheep Congress of Moscow, where the author purchased another flock of Karakuls, elaborate certificates were still issued with the sheep that were sold, stating that they were pure-bred Karakuls. Fortunately the author had already learned that only tested Karakul rams, free from fine wool admixture, would produce lambs with tight curls when bred to the coarsest wooled ewes.

After the results of my tests in the United States were placed before the convention a resolution was adopted to the effect that Karakul sheep should not be considered pure-bred, that fine wool must be eliminated, and that a ram must prove his ability to sire lambs with tight curled wool before he could be considered a full-blood sheep. Several of the breeders agreed with me that the tight curls could be produced in the first cross, but none of them knew the reason why. Not a single breeder present realized the destructive effect upon tightness of curl of fine wool, which lacks the required stiffness to hold the curls

closed and give them their pipe-like appearance.

After the convention the author proceeded to Bokhara and before leaving old Bokhara City discovered that the Russian Agricultural Societies had not shown great judgment in buying their rams, having failed to get them from districts sufficiently separated to insure their being of distinct strains. Therefore, a costly expedition into the heart of the Kara-Kum Desert was necessary to procure desirable breeding stock. Fortunately this was done in 1913 and 1914, just before the war, which would have made a later expedition impossible.

THE DEVELOPMENT OF THE BREED

It must now be evident to the reader why the author has always objected to the formation of a Karakul Association in the United States, and has never failed to ridicule any breeder who considered his sheep in the light of pure-bred Karakuls and talked of them as being registered.

Last year Dr. Harry Laughlin of the Carnegie Institute, and a professor of Princeton University, who is an authority on histology, visited the author's ranch in California. After discussing the subject of registering Karakul sheep with these gentlemen, and explaining to them that the only test of the quality of a ram is his ability to sire lambs having tight curls, they agreed that only those rams should be registered that produced such lambs in the first cross when bred with domestic ewes. Furthermore they advised that only such Karakul ewes should be registered as produced tight curls on their lambs in the first cross with domestic coarse wooled bucks, free from fine wool admixture. No Karakul should be registered that produced, when properly crossed, open curls (Astrakhan fur). Since this fur has gone up considerably in price, there would be no objection to the formation of a separate Astrakhan registry.

Tight curl producing Karakuls should be registered under Categories "A," "B," and "C," and the tests should be conducted by a committee composed of the most reliable Karakul breeders, assisted by furriers.

The author has discussed this matter with Mr. Tomlinson, Secretary of the American National Live Stock Association, who strongly favors calling a meeting of all Karakul sheep breeders with a view of forming an association. He believes such action is desirable, in order to give every breeder who has desirable rams a chance of recognition, and to bring about harmony and the right kind of cooperation within the industry. Only by exchanging the very limited number of high grade Karakul rams in this country, and eliminating fine wool, can the Karakul breeders expect to build up a big industry.

It is a pleasure to announce that Mrs. M. J. Hoff has agreed to finance the "Karakul Breeder" a monthly paper which should make its appearance in November. It begins to look as if the industry for which the pioneer breeders of fur sheep in this country have labored so hard, will finally be placed on a sound basis.

In conclusion it is worthy of note that no longer can Bokhara claim a monopoly of the Karakul industry, as the Bolsheviks have devoured practically all of the sheep of that country, and unless America saves the day, the raising of Persian Lamb and Astrakhan fur will be an industry of the past.

THE GENETIC SIGNIFICANCE OF INTRA-UTERINE SEX RATIOS AND DEGENERATING FETUSES IN THE CAT

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DURING the past year the work was undertaken of examining the uteri of pregnant cats, with the hope of throwing some light on several questions which are of interest from the genetic point of view. Through the courtesy of the Society for the Prevention of Cruelty to Animals in New York City it was possible to do this. The routine procedure was as follows: as the dead cats were removed from the gas tank in which they were asphyxiated, any females which showed evidences of pregnancy were put aside. These were then dissected, and records taken of the coat color of the mother, the number of fetuses, and sex of those present in each horn of the uterus, as well as the coat color whenever the embryo was sufficiently developed to show definite color pattern. The occurrence of any structural abnormality was noted, but these were found to be extremely rare. A few polydactylous animals were found. In each case where this occurred, some of the fetuses also exhibited the abnormality. One female was discovered to have a cystic ovary on the left side. The left tube of the uterus contained a degenerating fetus. This case has not been considered pathological, however, in the calculation of the data, since we have no knowledge of the influence of such an ovary on the surrounding tissues. Another case, that of a female in which a teratoma-like structure was found, is considered in detail in a later paragraph.

Doncaster[1] suggested that the occurrence of tortoiseshell males in cats and their usual sterility, might be due to hormone action somewhat similar to that apparently involved in the production of free-martins in cattle.[2] 148 pregnant cats were examined with a total of 653 embryos. Inspection of the uteri showed no sign of anastomosis of the circulatory systems supplying the fetuses in any case. This body of negative evidence makes the correctness of Doncaster's hypothesis seem extremely doubtful.

Of the 653 embryos, sex was determined in 613. The ratio was found to be 122.10 ± 8.30. This is very much higher than that usually found in mammals when it is determined at birth. It is interesting, however, to compare this figure with that found by Jewell[3] in fetal cattle of 123.21. These data are analogous, both being based entirely on embryos during intrauterine development. Comparison of this fetal ratio with existing sex ratios in cattle shows a wide variation. Wilckens[4] has given the ratio at or near the time of birth as 107.3. Pearl and Parshley[5] give the ratio

[1] Doncaster, L. The Tortoiseshell Tomcat—A Suggestion. *J. of Genetics*, Vol. IX. 1920.
[2] Lillie, F. R. The Free-Martin; a Study of the Action of Sex Hormones in the Fetal Life of Cattle, *J. Exp. Zool.* XXIII. 1921.
[3] Jewell, F. M. Sex Ratios in Fetal Cattle. *Biol. Bull.* XLX. 1921.
[4] Wilckens, M. Unteruchungen uber das Geschlechtsverhaltnis und die Ursachen der Geschlechtsbildung bei Haustieren. *Biol. Centrabl. Bd.* VI. 1887.
[5] Pearl, R. and H. M. Parshley. Data on Sex Determination in Cattle. *Biol. Bull.* XXIV. 1913.

as 113.3, and from more recent data Pearl[6] found the ratio to be 100.12. This last figure coincides more nearly with data collected by Gowen, giving a ratio of 101.58. King[7] found the sex ratio of rats at birth to be 104.6. Little has calculated the ratio in mice to be 103.1, while Weldon's material[8] gives a ratio of 104.1. The ratio in man was found to be 105 by Pearl and Salaman.[9] Unfortunately, there is no published data on the sex ratio at birth of cats, so that a comparison with the fetal ratio is impossible. We are therefore unable to tell whether there is a differential intra-uterine mortality between the sexes or not.

White coat color in cats has been recognized for some time past as a probable Mendelian dominant representing an extreme form of spotting. Little[10] has found a possibly similar case in mice. Here a factor with somewhat the same function behaves as a lethal when present in the duplex condition. To attempt to test this hypothesis for cats, the litters of white, or nearly white cats have been compared with those of non-white females. The cats classified as "nearly white" showed at most an area of color not larger than ten per cent of the entire coat. Since white, or nearly white cats, are not common, the chance of obtaining pregnant females was not great. Twenty-five were, however, obtained in the course of the experiment, with a total of 102 fetuses. The mean litter size of white females was 4.08 ± 0.13, while that of non-whites was 4.48 ± 0.07. The difference is 0.39 ± 0.15, which is 2.71 times its probable error. This, of course, is not a significant difference and can only be regarded as an indication of a possible diminution in the size of white litters which might have become apparent in the event of larger numbers. If this is due, as in the case of the mice, to the degeneration of the fetuses in utero, a larger number of degenerating fetuses should be found in the uteri of white females than in non-white. The records of degenerating embryos found have been kept, and show that out of 102 fetuses of white females, 11, of 10.78 ± 2.07 per cent were degenerating. In the non-white females, out of 551 fetuses, 25, or 4.54 ± 0.60 per cent were degenerating. The difference is 6.25 ± 2.16, which is 2.89 times the probable error. The figures for the non-white fetuses include one litter composed of four degenerating fetuses in utero, while attached to the ventral body wall was a teratoma-like structure inclosing a fetus which had apparently fully developed, and showed at that time the skeletal structure and hair formation of a full-term embryo. This case has been considered abnormal and pathological, and a recalculation of the number of degenerating embryos in non-white litters has been made on this basis. With this correction, there are 21 degenerating out of 547 fetuses, the percentage being 3.84 ± 0.58. The difference between whites and non-whites then becomes 6.845 ± 2.149, which is 3.2 times the probable error, which may be considered as a significant difference, although the percentages are so small that it is difficult to be sure of the significance of such a difference. Thus, the conclusion is probably warranted that a significantly greater number of degenerating fetuses are found in white than in non-white female cats.

From the nature of the material used it was impossible to know the sire of any litter, but, as has been stated before, the proportion of white cats

[6] Pearl, R. The Control of the Sex-Ratio. *Maine Agric. Exp. Sta. Bull.* No. 261. Part 3. 1917.

[7] King, H. D. and J. M. Stotensburg, (1915). On the Normal Sex Ratio and the Size of the Litter in the Albino Rat. *Anat. Rec.* IX.

[8] Weldon, W. F. R. Mice Breeding Experiments. Records of Matings. *Biometrika* XI. 1916.

[9] Pearl, R. and R. N. Salaman. The Relative Time of Fertilization of the Ovum and the Sex Ratio Amongst Jews. *Maine Agric. Exp. Sta. papers from the Biological Laboratory*, No. 48, Vol. II, 1913.

[10] Little, C. C. Note on the Occurence of a Probable Sex-linked Lethal Factor in Mammals. *Am. Nat.* LIV, 1920.

is relatively small. Since this is true, the probability is that in the majority of cases the sires were non-white. It therefore becomes likely that in some white female cats at least a lethal action of some sort is operative when the factor for white is present even in the simplex condition.

The writer wishes to express her indebtedness to Dr. C. C. Little under whose direction the work was undertaken and carried out, for his suggestions in the interpretation of the data.

The Manners and Morals of Wild Animals

THE MINDS AND MANNERS OF WILD ANIMALS. By William Hornaday, Director of the New York Zoological Park. Pp. 200. $3.00. Charles Scribners and Sons, New York. 1922.

William Hornaday, Director of the New York Zoological Park, writes of the manners and morals of wild animals with the authority bred by long and familiar acquaintance with his subject, and familiarity, in his case, far from breeding contempt, has engendered sincere admiration. "Some animals," he says, "have more intelligence than some men and some have better morals." To deny the thinking power of animals "in the face of the facts is to deny the evidence of one's senses." "The wild animal must think or die" is his contention upheld by many convincing records.

Wild animals, like men, says Mr. Hornaday, vary individually in ability, temperament, and morals. "The persistence of the mental and moral parallel between men and wild animals is a source of constant surprise."

The chimpanzee stands at the head of a list compiled to show the comparative intelligence of certain conspicuous wild animals. "The high class dog is the animal that mentally is in closest touch with the human mind, the feelings and impulses of man, and it is the only one that can read a man's feelings from his eye and facial expression."

The power of speech which is generally considered to be an attribute trenchantly dividing man from the so-called "lower animals," is, according to Mr. Hornaday, merely the result of man's attainment of a position in which life is not dependent upon caution. Wild animals are silent or have only a few simple vocal expressions, because silence is the price of life. Only the silent species have survived the age-long struggle for existence. Wild jungle fowl, the ancestors of our domestic chicken, move silently through silent forests where any sound might betray their presence to a score of patiently waiting, tirelessly watching, chronically hungry enemies, but our barnyard fowl, strutting and cackling secure in the protection of man, have developed a highly useful vocabulary of resonant language calls and cries which are quite intelligible to the attentive human listener. The absence of vocal language in wild animals is largely compensated by a remarkable development of sign language which, as is well known, is also the medium of communication among many savage tribes of the human race. Spoken words are not the only indices of real mental processes.

Mr. Hornaday describes in detail the mental and moral traits of apes, bears, elephants, ruminants, rodents, serpents, spiders, etc. and gives numerous anecdotes illustrative of their abilities, virtues and failings, with occasional (sometimes somewhat caustic) commentaries on parallel phases of human civilization.

A chapter on the rights of wild animals speaks in no uncertain terms of the duties of man with respect to his fellow-citizens of the world, asserting that the killing of harmless animals solely for sport and without utilizing them when killed is murder.

The liberal use of side-heads detracts from the literary character of the book, although it may be justified by the

greater ease with which attention is called to the individual subjects under discussion by this means. Still we cannot but have a lingering regret that the demand of present-day readers does not require the artistic touch which beautifies the works of Walton and Gilbert White. The book, however, is entertaining to a high degree and its greatest attraction, perhaps, is the spirit of sympathetic understanding which is the outcome of the writer's close association with his subject. If such a spirit were more common among men, an era of good will toward animals might bring about more peace upon earth, for the fear of man, the most terrible of all enemies, keeps alive in animals the passion of hate which is the seed of war. There is reason in the old motto, "Live and let live."

A. C. C.

The Dependent Organism

Organic Dependence and Disease: Their Origin and Significance. By John M. Clarke, D.Sc. L.L.D. New York State Paleontologist. 113 pages. Yale University Press, New Haven, 1921.

The author's thesis is that dependency of one organism on another, including mutualism beneficial to both parties, is a perturbation of normal living which spells inevitably increasing degeneracy for the dependent organism. Normal living is defined as "full activity of an unimpaired physiology, inclusive of the function of locomotion or mobility." The author's point of view may be gathered from selections from his conclusions. "If dependence has affected and sealed the fate of one great division of the Kingdom of Life, so that it is and must remain subsidiary to the larger purposes of nature, dependence also has entered upon, probably the major part of the other, the animal world." "It is thus emphatically true in Nature's program, that physical salvation is of the few, and is the reward only of righteous living." "For dependent races of life, there has been no rescue or return."

The thesis seems to approach perilously close to a truism. If progress is defined in terms of mobility, it is hardly likely that specialization in a form of dependency which involves fixation will lead to progress. Dependency which does not involve loss of mobility is apparently not looked upon as unrighteous and is not discussed. The whole animal kingdom is, of course, dependent on the plant kingdom having an unimpaired physiology with respect to the synthesis of organic compounds which involve storage of energy.

The greater part of the book is taken up a with discussion of the cases of symbiosis and parasitism among invertebrates which are revealed by the paleontological record. The sequences of increasing specalization and dependency illustrated by numerous photographs are of great interest apart from the ethical conclusions drawn from them.

S. W.

BOOKS RECEIVED

Mysticism, Freudianism, and Scientific Psychology, by Knight Dunlap, C. V Mosby Company, St. Louis, Mo., 1922.

Personal Beauty and Racial Betterment, by Knight Dunlap, C. V. Mosby Company, St. Louis, Mo., 1922.

Elements of Scientific Psychology, by Knight Dunlap, C. V. Mosby Company, St. Louis, Mo., 1922.

Plain Facts, by J. H. Kellogg, Modern Medicine Publishing Company, Battle Creek, Michigan, 1921.

Cancer, the Monster Malady, by J. H. Kellogg, Good Health Publishing Company, Battle Creek, Michigan.

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A PLANTSMAN'S DETECTIVE STORY

FRONTISPIECE. In Japan the skin of an orange called the *Yuzu* is widely used as a seasoning for cooked foods, and the extracted juice serves as a condiment, much as we use vinegar. The *Yuzu* is found semi-wild in southern Japan, and was long supposed to have been indigenous to that region.

Among the many plants discovered by Frank Meyer in China was a wild orange which he called the *Kansu orange*, after the province of Central China in which it was found. Plants of this orange were raised in the greenhouses of the United States Department of Agriculture at Washington, and they were found to be surprisingly like the plants of the *Yuzu* growing there. Examination of Meyer's photographs and botanic material revealed the interesting fact that the *Yuzu* and the *Kansu orange* were identical, thus establishing the interesting fact that this useful Japanese fruit had been imported from China a great many years ago.

This is the field photograph made by Meyer of the fruit of the *Kansu orange*. (See text, p. 245.)

CITRUS FRUITS OF JAPAN

With Notes on Their History and the Origin of Varieties through Bud Variation[1]

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Office of Crop Physiology and Breeding Investigations, U. S. Department of Agriculture

WHEN the citrus fruits of Japan are discussed, attention should be called to the fact that orange culture is one of the leading industries of my country, producing fruit of excellent quality and delicious flavor, with an annual return of more than fifteen million dollars. Other fruits, like persimmons, plums, apples, peaches, sandpears, and cherries are cultivated extensively, but none of them rivals the orange, thanks to the climatic conditions of the island, which throughout a large part of central and southern Japan seem more favorable to orange culture than to any other fruit industry.

In consequence of the utilization of flat areas for rice plantations, oranges are mostly planted on the slopes of hills, the sides of which are terraced on a great scale, using heavy stone walls to retain the soil.

The operations of planting, cultivation, fertilization, picking, hauling, and packing, are all carried on by hand, without the aid of heavy machinery. The fruits are shipped to markets and to centers of distribution by railway or by boat.

Systematic methods of selling have developed in recent years in many regions, and large packing houses and storage plants are constructed either by individuals or by cooperative associations of farmers. Within recent years the exportation of citrus fruits to the United States and Canada has been carried on under strict Government inspection, with every precaution against the dissemination of injurious insects and fungus diseases; but owing to our own excellent home market, the export trade has not developed into an important enterprise.

THE SATSUMA ORANGE

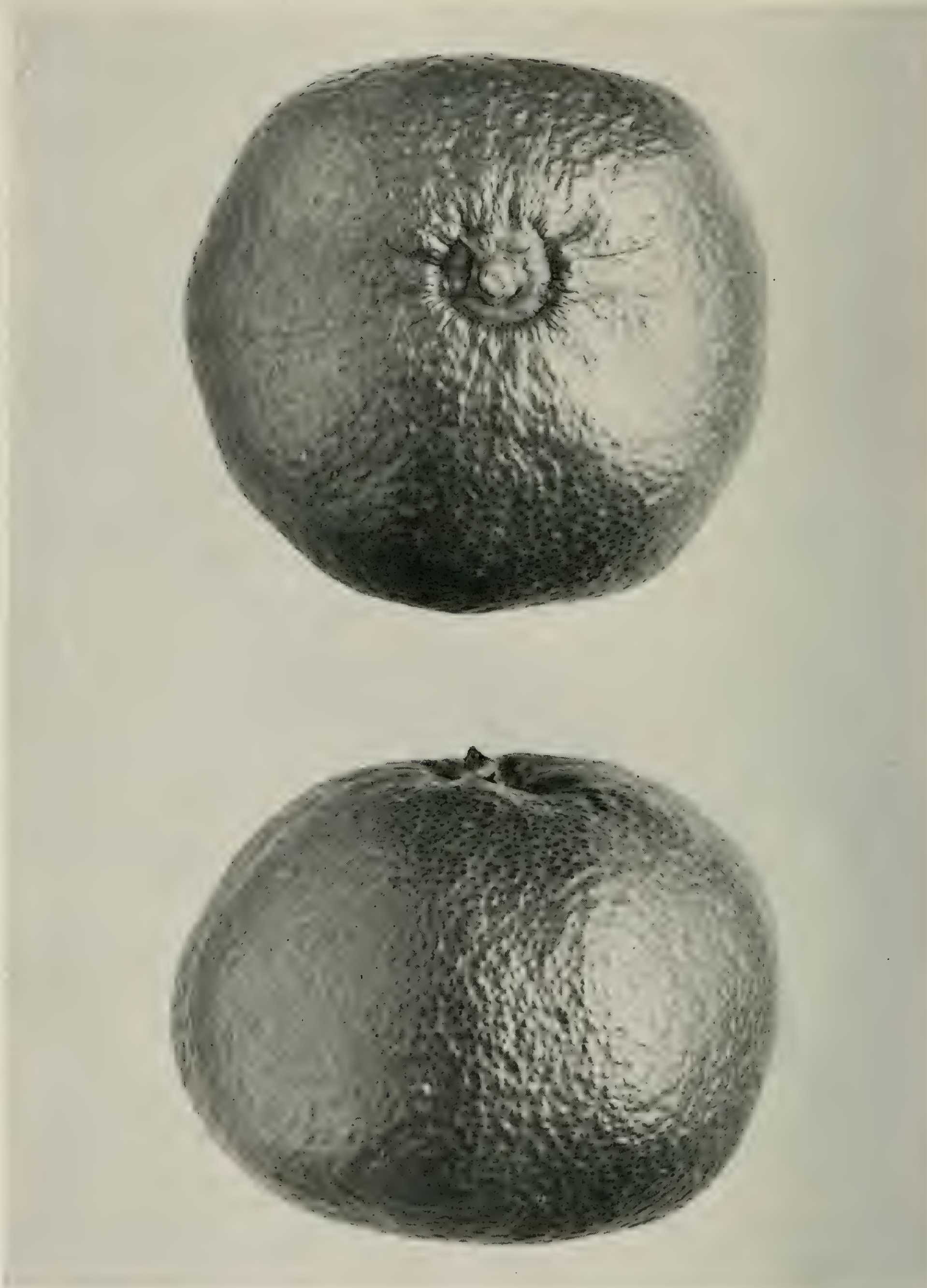
The leading orange grown in Japan is a kind of mandarin, *Unshû Mikan*, called the Satsuma orange in the United States. This variety forms nearly seven-tenths of our entire orange crop. The fruit of the Satsuma differs from the King orange in its soft, thin, rind of a bright orange color, and in its extremely sweet pulp. The leaves of the Satsuma are very large and drooping, with the petiole devoid of conspicuous marginal wings. From common tangerines the Satsuma orange is easily distinguished by the absence of the scarlet or vermillion tinge which characterizes the rind of the tangerines. The Satsuma also is distinguished by the well developed calyx-lobes of its flowers and in its very fine-grained, melting pulp, which is of good keeping quality.

This orange is now raised in the United States, principally in Alabama and other Gulf States, the Satsuma orchards in the Mobile Bay District alone covering an area of about 12,000 acres. Its future is highly promising, owing to the favorable climatic conditions of the region into which it has been introduced, and also to the existence of well organized business methods for handling the fruit. To the more efficient development of the Satsuma orange industry in this country the Office of Crop Physiology and Breeding Investigations is now directing some attention, endeavoring especially to introduce improved strains of varieties into actual cultivation.

NATSU-DAIDAI, A LARGE SUMMER ORANGE

The second important orange of Japan is the *Natsu-daidai*. This is a

[1] Read before the 160th Regular Meeting of the Botanical Society of Washington, at the Cosmos Club, May 2, 1922.



FRUITS OF THE WASÉ ORANGE

Figure 1. These oranges were bought in the Kobi market, Japan, on the third of November, 1919. They were forwarded to Washington where they arrived December the fifth, and this photograph was taken one month later. This was at least two months after they had been picked, during which time they had been shipped half way around the globe. The fine condition they were still in when photographed testifies to the remarkable keeping qualities of this variety. (See text, p. 251.) Photograph by E. L. Crandall.

large summer orange about the size and shape of a grapefruit; but it differs from the grapefruit in its more pitted skin, which is of a deep lemon-yellow, and in its coarse-grained, slightly bitter pulp, which matures in late spring. It is inferior in quality to a good grapefruit, but its extremely hardy nature and its resistance to citrus canker are appreciated by growers, as well as its admirable sturdiness which enables it to withstand rough treatment.

THE WASHINGTON NAVEL ORANGE

The third important variety of orange is the Washington navel orange which was first imported into Japan in 1891. It was absolutely new to the Japanese growers when it was first introduced, and much attention has been paid to the development of the navel orange industry, but owing to the humid atmosphere and lower temperature, it was found not to do so well as in southern California. Recently Japanese farmers have learned a special method of treating the plant, which checks its vegetative overgrowth and increases fruiting by means of severe pruning or dwarfing, like the treatment of lemon trees in Italy. The good keeping quality of the fruit made it especially desirable, and the Japanese were loath to give up its cultivation.

Other kinds of sweet oranges are plentifully produced in the southern part of the Kyûshû Island; but they do not reach the central markets, from which native pummelos and shaddocks are also absent. Over two hundred varieties of sweet oranges and pummelos are estimated to exist in Japan proper, and a number of promising shaddocks, like *Hirado*, *Egami*, or *Ogami*, are of sufficient importance to be multiplied for economic cultivation. A very prolific mandarin called *Yatsushiro* is often found in cultivation and the common China mandarin, called *Kishû Mikan*, or *Kinokuni* in this country, is more or less extensively grown. *Kunembo*, a variety of the King orange, is also commonly raised in southern provinces.

Besides these well-known kinds of oranges, a number of local varieties or fancy fruits are to be noticed, for instance *Anado* and *Tengu*, attractive for its red skin, but with rather insipid soft pulp; *Naruto* and *Sambô*, yellow skin oranges of late maturing, with good flavor; *Koji*, and *Suruga-yukô*, very early maturing small fruits of extremely smooth surface; *Keraji Mikan* of Kikai island, with very early maturing and extremely fragrant yellow fruit, *Hyûga Natsumikan*, with very late-maturing and very juicy medium-sized fruits.

A MYSTERY SOLVED THROUGH A PLANT INTRODUCTION

Mention should be made of an orange highly esteemed for seasoning cooked food, that is *Yuzu*, first called *Citrus Jonos*, by Siebold, in his *Synopsis Plantarum Oeconomicarum*, published in 1830. This plant grows semi-wild, in southern Japan, but is commonly planted in the yards of farm houses for its fruit. The peel is highly aromatic, and for flavoring cooked dishes and soup or fish it is superior to lemons or limes. The juice is used extensively in the place of vinegar for seasoning raw food and salads. Two hybrid varieties of *Yuzu*, *Yukô* and *Sudachi*, are extensively cultivated in Shikoku Island for vinegar substitutes and also for manufacturing citric acid.

In 1915, Frank N. Meyer, the great agricultural explorer of the U. S. Dept. of Agriculture, found a wild orange in Kansu, China, which he imported into this country under the provisional name "Kansu Orange." After a close comparison of a green house plant of the Kansu orange with the *Yuzu*, together with an examination of Meyer's photographs and notes, the writer found the two to be identical, thereby proving this extremely useful orange to be of Chinese origin.

The seeds of *Yuzu* are sometimes used for raising stock plants for the Satsuma orange, and it is believed by the farmers that plants grafted on *Yuzu* stock live longer and behave better than those grafted on Trifoliate

orange under certain local conditions, especially on hill-top situations where the available surface soil is apt to be very thin.

STOCK PLANTS

For stock plants, Japanese growers use the trifoliate orange almost exclusively, on account of its hardiness and the cheapness of the seed, for this species is extensively planted in hedges surrounding houses. Owing, however, to its high susceptibility to citrus canker, the farmers are having recourse to other species as stock for grafting navel oranges and other varieties of sweet oranges. The sour orange, or Seville orange, is also grown for its juice and seeds. It furnishes a vinegar substitute, not as good as the juice of the *Yuzu*.

A half-wild pummelo, *Yama-mikan*, resembling grapefruit more than anything else, is also used as stock in the southern part of Kyûshû island, like pummelo stock in this country. Recently experiments have been made with Rusk citrange at stations cooperating with the U. S. Department of Agriculture. This stock, it is hoped, will bring considerable improvement in the propagation of orange trees in Japan.

THE KUMQUAT

For preserved or ornamental fruit the kumquat is grown in various localities. This is a small fruit with sweet peel and a pleasantly acid pulp. It occurs in several varieties or forms, such as the *Marumi*, or round kumquat, the *Nagami*, or oval kumquat, and the *Meiwa*, or large round kumquat. Besides the kumquat the thick rind of pummelos is also preserved in sugar, making an excellent candy with a flavor of its own. Sliced Satsuma fruits candied in sugar are also extensively manufactured in southern countries. They make an attractive sweetmeat with a delicious flavor. The dried peel is also used in the preparation of various kinds of drugs. Orange peel and persimmon calyces are the source of a celebrated tonic pill, extensively manufactured by proprietary medicine corporations and conspicuously advertised on signboards throughout the Orient.

AN EARLY AGRICULTURAL EXPLORER

Having enumerated the principal citrus fruits grown in Japan, I turn now to the question of how this remarkably large number of varieties were introduced into actual cultivation. The first citrus fruits introduced into Japan came from China or from some other country of southern Asia. We have two historical accounts of their introduction. The most reliable, written in the Kojiki, or Record, compiled by Ono Yasumaro about 712 A. D., tells of the famous expedition of Taji Mamori, who was sent abroad by the Emperor Suinin in the year 61 A. D. and returned to Japan after an absence of ten years, bringing back eight leafy branches and eight leafless branches of citrus fruits. When he arrived at the imperial court he found that the Emperor was no longer living, and in his grief he took his own life, after having presented at the Emperor's tomb the fruits of his travels which he had hoped to lay at his Sovereign's feet.

Nothing is known of Taji Mamori's itinerary during his ten years of wandering in southern Asia, and the account of the fruit he brought back with him is obscure. According to the Nippongi, a chronicle compiled by Toneri Shinno in the year 720 A. D., the orange introduced by him was the *Tachibana*, the name of which was supposed to be a modification of *Tajima-na*, signifying "Named after Tajima." This explanation, however, is hardly possible; for the *Tachibana*, now occasionally seen as a sacred plant in the court yards of Shinto shrines, grows spontaneously and abundantly in southern Japan, where it appears to be indigenous. The fruit of the *Tachibana* is insignificant from an economic point of view, and the tree is of no importance except for the ornamental value of its small bright yellow fruit, which is too acid to be used for

food. The primeval forest of *Tachibana* found at Tsuro-mura, in the country of Aki, prefecture of Kôchi, has been officially registered as a Natural Monument Reservation of Japan. The *Tachibana* orange grows wild in great abundance not only in the prefecture of Kôchi but also in the province of Hyuga, and a locality named after the *Tachibana* appears in the earliest mythology of Japan.[2]

THE TACHIBANA

The handsome fruit of the *Tachibana* orange and its fragrant blossoms have for centuries been celebrated in poems by the Japanese, in whose coats of arms they also appear. Some of these poems are given in the *Mannyôshû*, or "Myriad Leaf Collection," a most brilliant relic of the ancient people of Japan, compiled about the year 750 A. D. It might be interesting to quote the following poems, in which so many centuries ago the *Tachibana* is named. These, like all Japanese poems, are characterized by their brevity. Each poem is a single thought embodied in a certain number of lines each composed of a definite number of syllables.

Wagimogo ga yado no Tachibana ito chikaku
Ueteshi yue ni narazuba yamaji.

This may be rendered as follows:

My lady's cottage very near
I set a Tachibana tree,
That its bright fruits from year to year
Might tell her of my constancy.

Another poem pictures the *Tachibana* in bloom:

Waga yado no hana Tachibana ni Hototogisu
Ima koso nakame tomo ni aerutoki.

Oh Cukoo, in my blooming Tachibana tree,
Sing loud with joy! My friend has come to me.

Flowers and fruits were formerly strung into garlands and necklaces by the ancient Japanese, as they still are strung by the Hawaiians of the present day. This ancient custom in connection with the fragrant blossoms and golden fruits of the *Tachibana* is commemorated in the following verses, written in the eighth century of the Christian era, when the Anglo-Saxons were still pagans and European literature was at its lowest ebb.

Satsuki no hana Tachibana wo kimi ga tame
Tama ni koso nuke chiramaku oshimi.

May offers thee fair Tachibana flowers,
Like beads to string into a garland sweet.
Oh hasten, lest the fleeting hours
May strew them withered at thy feet.

-oOo-

Waga yado no hana Tachibana no itsunikamo
Tama ni nukubeku sono mi narinam.

My Tachibana's fragrant flowers of spring
Caressed by summer's fervid, quickening air
Have borne fair fruits, like beads of gold, to string
In necklaces to grace my lady fair.

These ancient verses show that the *Tachibana* is not an imported plant, but one that has grown in Japan for many centuries. The identity of the citrus fruit introduced by Taji Mamori still remains in doubt. That he did bring a foreign plant into the Island Empire about the year 70 of the Christian era can hardly be questioned; for the incidents of his celebrated expedition and his tragic death form one of the most important chapters of the Chronicle handed down to us. This early account of an agricultural explorer sent on a mission for the purpose of discovering and bringing back desirable plants to his native country deserves to rank with that of the Queen Hatshepsut's expedition of

[2] In the account of the Creation, Izanagi, the Adam of Japan, had become separated from Izanami, his Eve, and sought her in every corner of the world. At last he went to the land of Darkness, where he found her indeed, not in the perfection of her loveliness, but in the form of a repulsive corpse, whose touch was pollution. He could not conceal his horror on beholding her, and in her fury she called upon the devils of Hell to expel him. On coming forth into the land of Light, the first act of Izanagi was to purify his body at a place, which the myth calls *Tachibana no Odo*, in the province of Hyûga. On washing his right eye a god was born, *Tsukiyomi-no-mikoto*, the Moon God. On washing his left eye, behold a bright aurora emanated from it; this was *Amaterasu*, the Sun Goddess, the first Ancestor of the people of Nippon. Thus is the name of *Tachibana* associated with the very beginning of our race.

1570 B. C., recorded in the hieroglyphics of Egypt and that of Chan Ch'ien, who imported alfalfa and the grape into China about the year 126 B. C. To these early explorers the agents of our own Office of Foreign Seed and Plant Introduction are worthy successors.

About twenty years ago relics of an ancient shrine dedicated to Taji Mamori were discovered in the village of Kamo-mura, county of Kaisô, province of Wakayama. Thanks to the enthusiasm and piety of Toranosuke Mayeyama, a citrus grower of the village, a new shrine was built and several stone monuments were erected on the site of the ancient relics, and recently the village council passed a resolution to establish a new plant-introduction garden and citrus experimental orchard near by, in memory of Tajima's expedition and to emphasize his patriotic spirit to benefit his country through the introduction of desirable foreign plants. It is interesting to see the development of such an idea which had not before been thought of great importance.

Going back to another record of introduction of a citrus fruit into Japan, attention is called to an account in the Shoku Nihongi, or Supplementary Chronicle, completed in the year 797 A. D. under the supervision of the Emperor Kwanmu, stating that in 725 A. D. the Emperor Shômu bestowed upon Harima no Otoe the Fifth lower junior rank of the Imperial Court on account of his successful importation of citrus fruits from China and the propagation of these plants in Japan. The name of the orange alluded to was written in Chinese *Kan ts'u* which corresponds to the *Kinokuni Mikan* now grown in many places.

INTRODUCTION OF THE YUZU

No record of the introduction of the *Yuzu* has been discovered. This name *Yu tz'u* in Chinese is now used exclusively to designate shaddocks in southern China and Formosa. It is not generally used in Chinese for the acid citrus fruit so well known in Japan under this name. In certain old works, however, like *Shuo wên*, the ancient dictionary compiled by Hsü Shen in the first century of the Christian era, and the *Powuchi* ("Record of remarkable objects") written by Chang Hua, who lived 232–300 A.D., there are descriptions of the *Yu tz'u* growing in China, which correspond to the orange with acid pulp which bears this name in Japan. The *Yuzu* plant is fairly well illustrated in the Atlas of *Shao hsing pên ts'ao* or the 1159 edition of the famous *Chêng Lei* herbal, quite lost in China but existing in manuscript copies restored in Japan. In all probability the name was applied to the acid *Yuzu* orange introduced into Japan from China and that the original Chinese name *Yu tz'u* gradually became obsolete in China itself.

THE SWEET KUMQUAT

Concerning the introduction into Japan of the sour orange, shaddock, sweet orange, *Kôji*, of the tangerine group called *Beni Mikan* in Japan, and the common kumquat, we have no record. In all probability they came to our shores on board visiting merchant vessels, as in the well-known case of the large round kumquat now called *Fortunella crassifolia* by Swingle. This improved kumquat was accidentally brought to us by a shipwrecked Chinese sailor of Ningpo, cast ashore at Miho, near the port of Shimidzu, Shidsuuoka-ken, where he was rescued by the natives. A preserved kumquat, which the shipwrecked man carried in his pocket, yielded seeds which were planted in a private yard, and which proved to be a type of fruit tree quite new to Japan. This happened during the Meiwa period, that is, between 1764 and 1771, and the Japanese name *Meiwa Kinkan*, or *Neiha Kinkan*, was accordingly applied to this variety. The original parent of the Meiwa kumquats of Japan is still growing in the place where it was first planted.

ORIGIN OF THE SATSUMA ORANGE A MYSTERY

The Satsuma orange, most important of all Japanese citrus fruits, is called

Unshû Mikan in Japan, the orange of Wen Chou, province of Chekian, China. The first valid name applied to this orange was that proposed by Okamura Shoôken in his manuscript work *Keien Kippu* (Monograph of Citrus) written about the year 1828. It gives a good description accompanied by an excellent illustration. The name *Unshû* had before that time been used in earlier works but it had been applied to varieties quite different from the common Satsuma orange. The *Yamato Honzô*, or Japanese Herbal, of Kaibara Ekken, published in 1709, applied the name *Unshû* to a variety with small thin leaves and fruit as large as the *Kino-kuni* Mandarin, with red rind. This description does not accord with the characters of the true Satsuma. In the Japanese-Chinese Cyclopedia, called *Wakan Saisai Dzue*, a work written by Terajima Ryôan and printed in 1714, a citrus fruit called the *Unshû* is mentioned but its leaves are described as resembling those of the *Yuzu* and its fruit, of the size of the *Kino-kuni* mandarin, and as having a thick peel and acid pulp. This description does not apply to the true *Unshû* of Japan. The earliest occurrence of the name *Unshû* in Japanese literature is in a work called *Teikin Orai* ("Family letterwriting") compiled by a Buddhist *bonze* named Gen'e Hôin in the 14th Century. The name also occurs in the *Kagakushû*, a dictionary of primary learning compiled by another *bonze*, Tôruku Hatotsu in 1444, but as there are no descriptions of the fruits mentioned in these works it is impossible to fix their identity. A very old *Unshû*, or Satsuma orange tree, which grew in the small village of Fukutoma-mura, in the prefecture of Fukuoka, died in the spring of 1920. Its age was reputed to be 300 years or more. The oldest living plant which I have seen was one in the prefecture of Oita, growing to a height of 25 feet with its branches spreading over an area of about 40 feet in diameter. It must have been at least 200 years old. The vestiges of a similar tree which had fallen in recent years were also observed. These instances show that the Satsuma orange is a variety which has been known to the Japanese for at least 300 years, although its cultivation on an economic scale was not undertaken until about 40 years ago. It is entirely unknown in China. A local tradition current in the prefecture Fukuoka attributing its origin to the Taikô Korean Expedition of 1592–1597 is in all probability erroneous; since the climate of Korea is too severe for oranges of any kind.

It might be supposed to be of hybrid origin, like many other cultivated fruits, were it not for the fact that the Satsuma has not a single character in common with any other known orange. *Kunembo*, a botanical variety of the King orange, and the *Yatsushiro* are most nearly like the Satsuma in general appearance, but botanically they are quite remote from it. The Satsuma is really a good botanical species, though botanists may hesitate to give it a specific name until the mystery of its origin has been solved. Like maize or Indian corn, its ancestry has not yet been fixed; but it seems advisable to regard it as a distinct horticultural species with a specific name of its own. It seems to me after twelve years' experience with citrus fruits, that the only possible way to treat the group botanically is to regard a number of the distinct forms as horticultural species.

ORIGIN OF NEW TYPES OF CITRUS FRUITS

I come now to the discussion of the origin of new types of citrus fruits. The activities of the Office of Crop Physiology and Breeding Investigations of the United States Department of Agriculture have resulted in the development of thousands of new forms by means of artificial hybridization and selection. It is therefore quite natural to think that hybridization is an important method of obtaining a desirable novelty. Orange hybrids may sometimes lose the parental characters entirely by assuming an intermediate form; but among hundreds of plant characters there must remain some

POT-GROWN PLANT OF WASÉ SATSUMA

FIGURE 2. It is not known how the Japanese Satsuma orange originated, but it has been cultivated for at least three hundred years. Concerning the *Wasé* variety, we know quite definitely that it was discovered about twenty years ago as a bud sport of great promise in a grove of oranges on the Island of Kyûshû. The fruit of the *Wasé* is large and flat and matures much earlier than the other varieties of Satsuma orange. Photograph by E. L. Crandall.

which will behave as Mendelian dominants. For instance, the hairiness of of the ovary, the trifoliate form of the leaves, and the existence of oil in the pulp vesicles are in many cases Mendelian dominants in crosses between the trifoliate and other kinds of oranges. The strong aromatic substance in the rind of the *Yuzu* is also inherited without much reduction by its offspring. Wedge-shaped seeds and the well-developed marginal wings on the petioles of the leaves of pummeloes are also handed down in varying degrees to their descendants, and in addition to these, other dominant characters could be enumerated.

It is difficult, however, to explain the origin of some of the characters which make their appearance, as the absence of seed in the Satsuma and the Washington navel orange. In the flowers of these oranges the male or staminate organs are absolutely abortive, and sometimes the female or pistillate organ lacks the function of fertilization. Vegetative nucellar tissue may develop into the embryo without the intervention of spores. This phenomenon is generally called *apogamy*. The seed thus formed when planted produces a plant exactly like the female parent, whether it has been subjected to cross-pollination or not.[3] A great many plants produce seed by apogamy, and all efforts to obtain hybrids by cross pollinating them are ineffective. Hybridization, therefore, cannot be the only way to create new horticultural varieties. In the Satsuma orange there are several distinct groups or sections, which differ from one another, in some cases by the habit of the tree, in others in the shape and size of the leaves, in others in the time of ripening the fruit, or perhaps in the appearance of the fruit itself.

THE WASÉ SATSUMA

One group, called *Ikeda*, has numerous small leaves and round fruits; another called *Owari*, has larger leaves and flat fruits. From the latter is segregated a strain with very large leaves, and large, flat fruits. This is generally called, by the Japanese *Kairyô*, or improved *Unshû*. Another striking variety, of promising economic value, is the *Wasé*, first found in the village of Aoe on Kyûshû Island, about twenty years ago, and now ranking highest among all the oranges in the market. The discovery of the *Wasé* orange was just an accident, but its development into an important industry was due to the keen business mind of the Japanese farmer. Just how these different varieties originated is not known; but one thing is quite certain, they are not of hybrid origin

With the encouragement and help of Mr. Walter T. Swingle, I took up the study of citrus fruits in the hope of securing the best type of large-fruiting, early-maturing strains of the Satsuma orange in Japan, which might prove of value to growers in the Gulf states of this country. In the American markets, as everybody knows, fruit is very scarce from October 1st to November 15th; if ordinary varieties of Satsuma are raised, the markets of this season can partly be supplied by fruit from the groves of Alabama. In 1920 the first carload of Satsumas was shipped as early as November 11th. During the last year it was possible to ship this fruit as early as October 23, using artificial methods of curing. There still remains a period of 20 days when oranges are very scarce in the American market. In this connection attention is called to the fact that Japanese citrus growers ship the fruit of *Wasé* oranges as early as September 20.

Wasé is a very distinct fruit, characterized by large round form, extremely thin, polished rind, and very abundant coarsely grained pulp (see Fig. 1). Its leaves, petioles, dormant buds, flower-buds and calyx characters are quite different from all other strains of Satsuma, so that it may well be regarded as a good botanical variety.

[3] SWINGLE, W. T. and T. R. ROBINSON. A New Tangelo. *Journal of Heredity* XII: 151-153, April, 1922.

NEW VARIETIES BY BUD VARIATION

The oldest *Wasê* tree, now about 70 years of age, is found in the village of Aoe, prefecture of Oita. Three younger plants from which the present commercial variety was taken, also exist in the same village. All of them are grafted, and we know not whence they came; but the discovery of almost exactly the same form of orange on a branch of an entirely different kind of Satsuma, threw a new light upon the question of the origin of varieties. In the village of Tsukumi, not far from Aoe, a farmer discovered very early-maturing fruits borne on an ordinary *Owari* Satsuma tree. A careful study of the fruits and flowers of this tree by the writer proved this early variety to be identical in all respects with the *Wasê* originating at Aoe. It was a clear case of progressive or beneficial bud-variation. It is of great interest to note that variations of this kind are by no means very rare; they are, on the contrary, rather to be expected, as a careful study of the phenomenon has shown. In the villages of Hisatomo and Ochô, in the prefecture of Hiroshima, on the inland sea, other strains were found which had likewise originated from bud variation. The characters of the new *Wasê* growing in these places, are slightly different from one another, as well as from the Aoe and Tsukumi *Wasê*. In four different villages of the prefecture of Shidzuoka, I found different strains of *Wasê*, which had undoubtedly originated from bud variations. These bore a general resemblance to one another, but when carefully studied, all of them proved to be distinct. Some of these new varieties have been propagated by grafting and their progenies have, in all cases, been found to possess the new characters without alteration. Commercial orchards of the *Wasê* variety, descended from trees of the village of Aoe, also continue in the main, true to type, but it is especially interesting to note the tendency of the *Wasê* to revert to the parental *Owari* form.[4]

TENDENCY TO REVERT

Early growers of commercial *Wasê* trees noticed that a certain percentage of their plants did not come out as *Wasê*, but reverted to the *Owari* type; and they suspected that there was some mistake made in selecting the budwood. Later it was observed that *Wasê* trees sometimes send forth branches bearing leaves and fruits quite different from those of the typical *Wasê*, but closely resembling the ancestral *Owari* forms. These are clear examples of vegetative reversion, which is known to occur only in a limited number of cases on bud sports, or varieties resulting from mutation. A careful study of this phenomenon convinced me that it is very common in the *Wasê* of Aoe. To cite an extreme case, twenty-seven trees out of one hundred were found to bear branches having the characteristics of the ancestral form on which the variety had appeared as a bud variation. This demonstrates the importance of selecting with the greatest care the buds to be used for propagating.

Whether the *Wasê* is a real somatic mutant or a "chimera" we know not. If a chimera, its reversion to the ancestral form can easily be explained; for most chimeras behave in the same way. At the same time we must expect the occurrence of unchangeable *Wasê* by a similar procedure. We do not know whether or not absolutely constant *Wasê* exists; but of one thing we are quite certain, that bud variation and vegetative reversion are associated phenomena in plants belonging to the genus Citrus, and this may also be true with mutants of other plants not included in the family Rutaceae, though in this connection our knowledge is still scanty. Variegated leaves associated with striped fruits originate by bud variation; and it is well known that in these variegated forms reversion to

[4] TANAKA, T. A New Feature of Bud Variation in Citrus. *Circular 206*, U. S. Department of Agriculture. 1922.

plain color is quite common. Willow-leafed forms associated with elongated fruits also occur from bud variations and often revert to original normal types.

Perhaps the most striking case of vegetative reversion is presented by the corrugated form of *Shûji Mikan*, or Spicy Mandarin, in which two distinct forms of fruit and leaves are always found simultaneously on the same plant. These instances suggest the probability that a closer study of bud sports and sexual mutants will reveal the secret of reversion, the phenomenon opposite to original mutation. Attention is also called to the important rôles which these phenomena may play in the evolution of living organisms, and in the solution of the great problem of the origin of species.

The study of natural phenomena through the behavior of our economic plants is full of interest to the naturalist. The case of the *Wasê* orange is one of the most interesting in this connection, not only to the student bent upon discovering nature's secrets, but also to the horticulturist ready to apply such discoveries to the material advantage of mankind. Nature is always ready to respond to our appreciation and to reward our interest in her laws. It is to the agriculturist that she seems ready to yield her richest treasures.

In conclusion may I quote an ancient Japanese poem which presents this very thought:

"Ametsuchi no Megumi wa tsuneni mujinzô
Kuwa de horitore, Kama de karitore."

which may be rendered in English:

"To mankind boundless wealth is given
By fertile Earth and gracious Heaven.
Then dig ye deep into the mold
And reap your crop of burnished gold."

The Place of Heredity in Biology

FOUNDATIONS OF BIOLOGY, by LORANDE L. WOODRUFF, Professor of Biology in Yale University. Pp. 476, 211 figures. New York, The Macmillan Company. 1922.

It is of genetic interest to find that Professor Woodruff, in putting together what he considers as worth while for "the college student and the general reader" after several years of experience in teaching young men at Yale, has placed unmistakable emphasis upon heredity as one of the important "foundations of biology." This emphasis did not characterize biological textbooks of a generation ago.

The chromosome cycle, mutations, Mendelism, sex-determination, linkage and pure lines are among the many topics that are rescued from the closet of the specialist in this excellent book and made common intellectual property.

The chapter upon "The Heritage of the Individual," in which the task of selecting the important and discarding the irrelevant in the field of heredity has been admirably carried out, closes with the following summary:—"In the first place, it appears clear that the basis of inheritance is in the germinal rather than in the somatic constitution of the individual. A character to be inherited must be innate in the germ cells, and there is no satisfactory evidence that modifications of the body, 'acquired characters,' can be transferred to the germ and so inherited. Secondly, characters or groups of characters are usually, if not universally, inherited as definite units. These follow Mendelian principles of segregation and recombination in the formation of the germ cells of an individual, so that paternal and maternal contributions are readjusted in all the combinations which are mathematically possible. And, finally, the germinal factor basis (genes) of unit characters is remarkably constant. Selection is apparently powerless to alter it, but merely sorts out what is already there, or, taking advantage of such changes (mutations) as do occur, determines their survival value for their possessor in the struggle for existence."

H. E. W.

SUPERBA AND ITS PARENT TYPE

FIGURE 3. *Nephrolepis hirsutula*, of which *superba* is a variety, grows wild only in the Asiatic tropics. Its fronds somewhat resemble those of the sword fern (Fig. 7), but they differ in several respects. The prize for the fern with the most beautiful fronds would undoubtedly go to *N. superba*, the pinnae of which are ruffled and lobed in an exquisite manner. Unfortunately this form and all varieties of *N. hirsutula* can be grown only under the most favorable greenhouse conditions, so that it is entirely unsuitable for cultivation by commercial growers, and by most amateur plant fanciers. (See text, p. 257.)

WHICH BOSTON FERN IS BEST?

PROSPECTUS OF AN EXPERIMENT TO ANSWER THIS QUESTION

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TO STATE that the Boston fern in its many varieties is the most important of cultivated ferns is a truism. To judge the supreme excellence of one variety is a matter less readily determined. During the eight years in which a scientific study of the varieties of Boston fern has been carried on at the Brooklyn Botanic Garden, the commercial aspects of these ferns have aroused interest. Practically all the named and unnamed varieties of Nephrolepis are under cultivation there; it has therefore been possible to form some general opinions on the qualities of the different kinds.

Within the last year experiments have been undertaken with the aim of determining accurately, by means of test cultures, the relative characteristics of the different commercial forms. For the present, only the once divided or once pinnate forms are under consideration. A test of single plants of about twenty-five different varieties has already been made over a period of six months. These plants were placed in separate compartments of the stock bench in rich soil with good drainage and light. But it is obvious that such a test cannot possibly furnish the basis for the accurate conclusions desired. A second six-month's test is under way but even this will not be adequate for final determinations. The limited space at the Botanic Garden makes it impossible to grow a large enough number either of stock plants or of their progeny in pots. Because of this condition the writer has asked the cooperation of commercial growers, experiment stations, and agricultural colleges in effecting tests sufficiently extensive for obtaining conclusive evidence. To this end arrangements are being made to send sets of small plants of the many varieties to those who will undertake to make careful tests under standardized conditions.

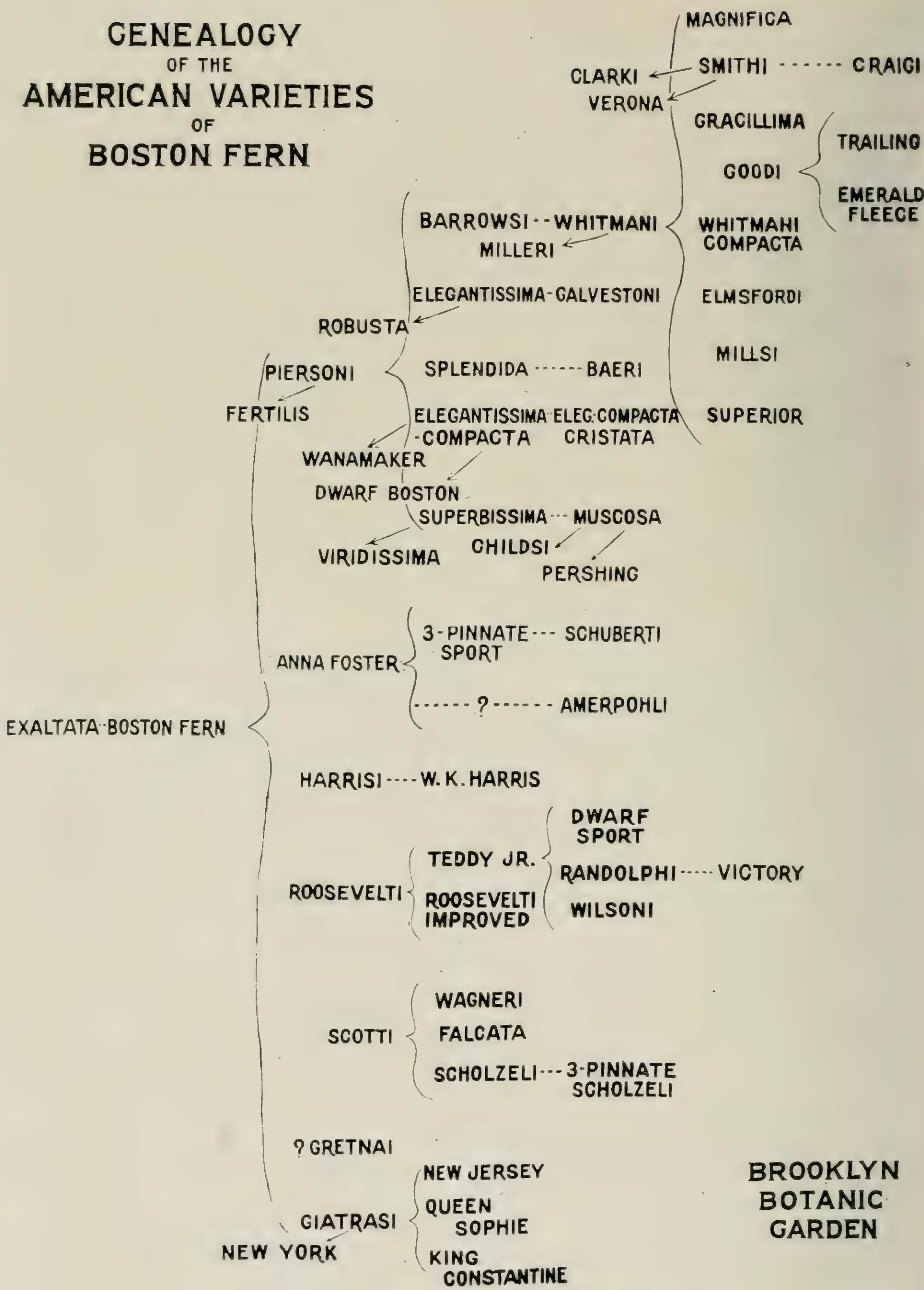
Experimenters generally will be gratified by the results of their investigations. The commercial grower in particular will derive more than one benefit; the varieties in the set will produce salable plants; such a set of different kinds will furnish excellent material for exhibition at flower shows; the knowledge gained will more than compensate for the extra time required to make the necessary observations. Some growers may hold that they already have a knowledge of the cultural qualities of the different kinds of ferns sufficient to their needs, but it is plain that most growers apply their knowledge to a relatively small number of different varieties. More widely disseminated knowledge of existing varieties will avail commercial growers as a group by checking the introduction, as new forms, of varieties already in the trade.

UPON WHAT BASES OF JUDGMENT IS THE BEST FERN TO BE DETERMINED?

In judging ferns for home usage and the purposes of the retail florist, appearance and lasting qualities are probably the most important factors. The commercial grower would also add the cultural characteristics as a third basis. A number of different bases of judgment may be summarized as follows:

(1) Appearance; size; beauty and grace of leaves; color and cutting of leaves; compactness and symmetry of whole plant.

(2) "Hardness" or "softness," i.e., the keeping qualities under the conditions of the home and retail florist shop.



THE FAMILY TREE OF THE BOSTON FERNS

FIGURE 4. The original Boston fern was discovered about 1895 as a sport from the wild sword fern. Since then nearly two hundred bud variations have been recognized, of which about one hundred have been named. The primary sports of the Boston fern are of four kinds, divided, ruffled, dwarfed, and fish-tail (in which the tip of the pinna is split). These characters are developed to a higher degree in the secondary sports. The arrows indicate a reversion to a simpler type.

A USEFUL FERN FOR BASKET WORK

FIGURE 5. This fern is not in the Boston fern series, but is a separate species, *N. pectinata*. It makes a particularly fine growth for basket work, producing a great profusion of slender, gracefully drooping fronds.

(3) Productivity in runners.
(4) Response after transplanting, that is, slow or quick growth.
(5) Continuity of growth throughout the entire year.
(6) Ease of care. i.e., with overhead watering and so forth.
(7) Special characteristics for special uses, as for basket work.

It may be noted, as suggested above, that there are several different points of view in judging these plants. The mail order florist will have preferences different from those of the jobber; the city retail florists' demands will not be the same as those of the small retail grower with neighborhood customers. The fern specialist will be interested in other characters than the general grower who will want a variety to serve as a rotation crop in connection with various kinds of flowering plants.

CHARACTERISTICS OF INDIVIDUAL VARIETIES

The prize for the most beautiful leaves among Nephrolepis varieties would probably go to N. "superba" (*N. hirsutula superba?*), an English form in which the leaves are ruffled and lobed in exquisite fashion, each having the effect of a graceful plume. (See Fig. 3.) Unfortunately this form and all the several other varieties of *N. hirsutula*, an East Indian species, are culturable only under the best greenhouse conditions, so that this form is not valuable at all for ordinary American commercial growers.

Another Nephrolepis form not in the Boston fern series, but a separate species, *N. pectinata*, which produces a great quantity of slender, graceful, drooping leaves, makes a particularly fine growth for basket work. (Fig. 5.) Although almost unknown in the American trade, it has possibilities of some value for this special work.

There is no question that the varieties derived from *N. exaltata*, the wild parent form of the Boston fern, are the best for all-around use, particularly for home growth. It is unfortunate that definite knowledge of the origin

of the Boston fern itself is not at hand. That it arose from the wild sword fern, *N. exaltata*, (See Fig. 7) can scarcely be doubted. That it is an improvement horticulturally over the wild form is also certain. The cultural excellence of the Boston fern is pronounced. It produces more leaves to a given size pot; the leaves are less stiff, and more graceful; they are less "seedy," that is, less fertile than the wild forms, in which the leaves are heavily laden with the brown fruit dots, and their spore product is deposited upon lower leaves as a disfiguring dust. Furthermore, the Boston fern is quicker in growth and reproduces much more rapidly than the sword fern.

It is interesting to note that even among the wild forms there are variations in growth habits and leaf characters like some of those in the Boston fern series. Two plants of the wild sword fern are shown in Figure 7; both came originally from Florida. They had exactly the same culture in the greenhouse, having been grown side by side, but there are evident differences in the shape of the whole plant, in the length and carriage of individual leaves, and in the conformation of the leaf divisions or pinnae. Ruffling of the leaflets which distinguishes the Harris and Roosevelt varieties of Boston fern also occurs in the wild type. Both plants shown were originally collected in Florida, one by Dr. John K. Small of the New York Botanical Garden; the other was obtained through the Bureau of Plant Industry.

With respect to the other varieties illustrated, attention may be called to the fact that two of these, "Teddy Jr.," and "Randolphi," (Fig. 8) exhibit excellence in the production of numerous leaves to form symmetrical, compact plants. Both are deservedly popular as quick growing types and also because a full-grown plant is smaller in size, and often more convenient for store purposes as well as for the home. Mentioning them in this connection is not in any way an attempt to answer the question asked in the title, but, merely to call attention to certain characteristics that make them especially appropriate for particular uses.

It will be noted that the largest plant, a specimen of the wild sword fern from Florida, shows a spread of leaf of practically six feet, with individual arched leaves four feet long. Leaves of wild plants in Florida have been measured over twenty feet in length. The second plant, called Teddy Jr.,

Ferns included in the present Experiment at the Brooklyn Botanic Garden

Name of Fern	*Home Locality*
Boston	F. C. Becker, Cambridge Mass. & others.
Childsi	J. L. Childs, Floral Park, L. I.
Dreyeri	Dreyer Bros. Whitestone, N. Y.
Dwarf Boston	F. R. Pierson, Tarrytown, N. Y.
Edmonton	H. B. May & Sons, Upper Edmonton, Eng.
Falcata	Peter Wagner, Brooklyn, N. Y. (There is also an English falcata)
Giatras	George Giatras, West Hoboken, N. J.
Gretna	B. M. Wichers & Co., Gretna, La.
Harris	Wm. K. Harris & Co., Philadelphia, Pa.
McCaw	McCaw Bros., Norwood, Pa.
New Jersey	George Giatras, Hoboken, N. J.
New York	George Giatras, West Hoboken, N. J.
Randolph	Randolph & Sons, Verona, Pa.
Roosevelt	American Rose & Plant Co., Springfield, Ohio.
Schubert "dwarf Boston"	Schubert Bros., North Bergen, N. J.
Scott	John Scott estate, Brooklyn, N. Y.
Splendida	Good & Reese Co., Springfield, Ohio.
Sword	Florida (wild)
Teddy, Jr.	Am. Rose & Plant Co., Springfield, Ohio.
Victory	F. R. Pierson, Tarrytown, N. Y.
Viridissima	F. R. Pierson, Tarrytown, N. Y.
Wagner	Peter Wagner, Brooklyn, N. Y.
Wanamaker	Robert Craig, Philadelphia, Pa.

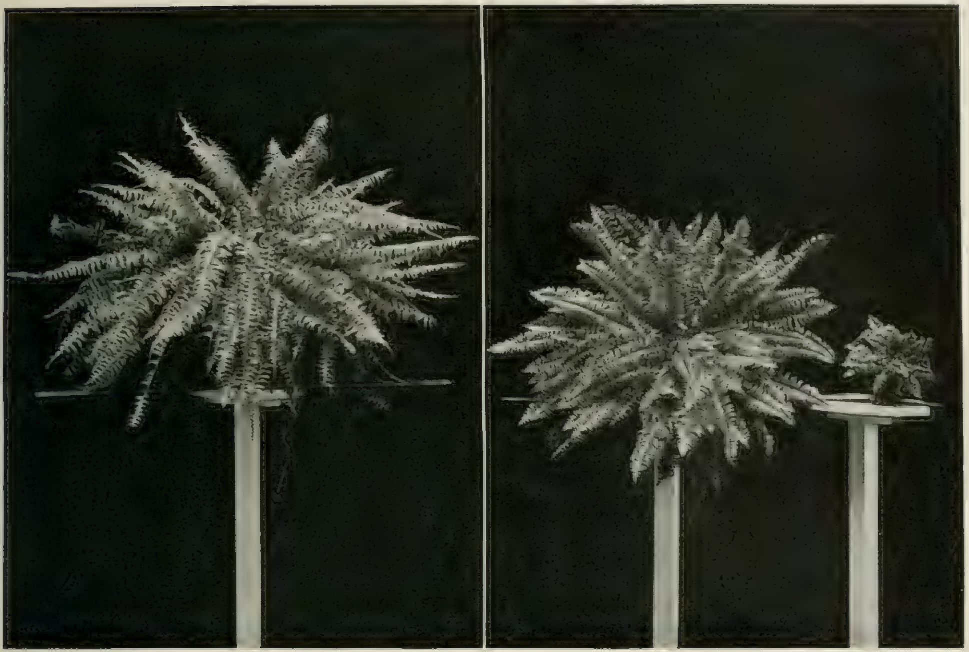
THE BOSTON FERN REPRODUCES ONLY BY RUNNERS

FIGURE 6. Many species of ferns reproduce both by runners and by spores, but the Boston fern produces no spores, so that new varieties arise only as bud variations of the stolons or runners, which are given off in association with each leaf. The stolons bear the roots which supply the main stem and leaves with food, and at intervals they also give rise to new plants by budding. The plant shown is a type of sword fern collected in Porto Rico for the New York Botanical Garden.

WILD SWORD FERNS FROM FLORIDA

FIGURE 7. The smaller one is the typical form, while the other is a variant. The larger plant differs from the normal in other respects than size. The pinnae are set farther apart and are all curved backward with hooking tips. The fronds are also somewhat more curved, but are not so graceful as those of a Boston fern grown under similar conditions.

The sword fern is the progenitor of the Boston fern, which appeared as a bud sport.



A PROGRESSIVE SERIES OF DWARF VARIETIES

FIGURE 8. This picture and the preceding one are on the same scale. Some forms of the wild sword fern (Figure 7) measure six feet across. The leaves of the different forms are progressively more ruffled and crinkled. Such a series arising in a definite sequence illustrates the orthogenic theory of evolution.

is a direct descendant of the Roosevelt fern, and has all the vigor appropriate to such a name encompassed within a spread of but three feet. The third fern, "Baby Randolph," is also a descendant of Teddy Jr., but still smaller, the last fern in the picture is an unnamed sport of Teddy Jr. Its leaves are less than six inches long, but very much crisped and ruffled, having, as it were, a natural permanent wave.

This variety may practically be counted out of the race at the start. It has attractive leaves, and makes a well-shaped plant, but grows too slowly to be of general value. Although it has appeared as a new form in the greenhouses of several florists, it has never been deemed sufficiently valuable to receive the distinction of a definite name. On the other hand, there are undoubtedly people to whom its dwarf prettiness would have a special attraction.

THE VARIETIES INCLUDED IN THIS TEST

On page 258 is given a list of the varieties included in the experiment at the Brooklyn Botanic Garden. It will be noted that all belong in a single class of the Boston fern group,—i.e., those with the leaves merely once-divided or once pinnate. It is not possible at the present time to include the numerous plume and lace varieties. The number of plants to be tested would then run over one hundred. As a matter of fact, for ordinary growth characteristics, the "plain" Boston fern types undoubtedly surpass the others.

Are there any other entrants? Any omitted names? New ferns may be entered in the competition. If desired, the plants will be received with the understanding that they will be held strictly at the Botanic Garden for comparative growth, and not sent out to any of the other establishments

A HUGE NEPHROLEPIS

FIGURE 9. *N. biserrata* grows wild in Florida and throughout the American tropics, but the ordinary type is not nearly so attractive as this form, the source of which is not definitely known. Grown in a hanging basket it makes a particularly fine conservatory plant.

at which the experimental contest may be held.

TECHNIQUE OF THE EXPERIMENT

In carrying out the experiment it is necessary to observe considerable care in growing the different varieties to avoid possible mixing. This is due to the fact that these plants reproduce by means of long slender runners or stolons (See Figure 6). The latter vary in length and vigor of growth in different varieties. In some types they may penetrate the soil or run along the surface five or six feet in various directions, taking root occasionally and producing scattered bud plants as outgrowths from the runner. Even in the less vigorous, smaller varieties, these runners may penetrate the soil for considerable distance in all directions, so that it is necessary in growing a series of different kinds in proximity to each other to take particular pains to avoid mixing. The suggestions outlined below cover methods aimed to keep the different varieties distinct.

(1) Separate the different kinds to avoid mixing; runners will mix six inches and more deep.

(2) Plant unlike kinds together so that mixing may be easier to detect.

(3) Lift runners and stock plants very carefully, so that the connections may be traced to the mother plant.

(4) Small varieties may be stocked in large flats if other conditions are kept uniform.

(5) Plants should be kept labeled and, in addition, a record of the position in the bench should be kept.

(6) Determine productivity by a careful count of all runners large

enough to grow after a six months period.

(7) Continue productivity test a second six months to determine whether different varieties are equally good throughout the year.

(8) Raise all runner progeny under uniform conditions, which are probably most certainly secured in pots.

(9) Label all potted runners or keep the pots together in flats and label one or more in each flat.

(10) Keep similar types separate to avoid danger of mixing pot plants.

(11) For productivity tests, select single plants of as near the same condition of growth, number of leaves, stolons, habits, color, freshness, etc., as possible. At the start of the first six months test, uniform runners may be difficult to obtain but for the second six months, the new stock plants can be taken directly from the old bench.

As a supplement to the test it is hoped that arrangements may be made to establish competitive classes at flower and plant shows as they are held in the course of the next year and afterward. Such classes might well include the following:

1. Best single specimen plant of any Boston fern variety.
2. Best group of ten plants of any single variety as grown for the trade.
3. Best ten plants of any dwarf variety in three inch pots.
4. Best collection,—single plants,—of ten or more distinct once-divided Boston fern varieties.
5. Variety with the most beautiful leaves.
6. Best single basket plant grown as exhibited.

Are there any other important items that have been overlooked? Are there any recognized published standards for judging specimen plants like those used at exhibitions? Should there be separate classes specifying the conditions of growth? Suggestions and cooperation in conducting this competition are earnestly desired.

THE HOME OF THE INDO-EUROPEANS, by Harold H. Bender, Professor of Indo-Germanic Philology in Princeton University. Pp. 57. Princeton Univ. Press, Princeton, N. J., 1922.

We are wont to look for information about past ages and peoples to museums where are displayed the findings of archeologists and anthropologists. Occasionally we are led from the familiar path by the fire of a new idea that takes us through ways less trodden but no less inviting. Such is the case when Professor Bender directs us by the road of philology to the probable home of the Indo-Europeans.

Language is one of man's greatest gifts, and his utilization of it makes it possible for us to learn something of man himself. The discovery of the relationship of most of the languages of Europe with one another and with those of India and Persia, and recognition of their common ancestry from a prehistoric tongue, was an important one in evolutionary science. Since this discovery the question of the original home of the Indo-Europeans, who spoke this ancestral language, has been a problem to attract countless philologists, archeologists, and anthropologists. Professor Bender believes the solution is to be indicated by linguistic science.

Approaching the problem by the route of modern philological research, Professor Bender reaches the detached attitude of science and employs the process of elimination. The presence or absence of words in the Indo-European languages allow and cause the elimination of certain geographical sections, at one time or another believed to be the home of the Indo-Europeans. The prevalence in almost every Indo-European language of a word for honey or for an intoxicating drink made from honey shows that the primitive home of the Indo-Europeans must have been a honey-land. Again, names of flora and fauna existing in these languages give general indications of the climatic conditions in the home of the Indo-Europeans. The cumulative evidence drawn from vocabulary makes the position that the home of the Indo-Europeans was southeastern Europe appear tenable. The technical apparatus of philology with its division of *centum* and *satem* languages, Grimm's law of consonants, and other precepts, introduces further support for this belief.

Professor Bender anticipates considerations that might be offered as objections. Traditional beliefs are overthrown and these refutations become supporting qualifications in his convincing dialectics. The arguments are so logical, the evidence so decisive, that the reader is satisfied that the plain of eastern central Europe, in which live the Lithuanians, who have preserved more faithfully than any other people on earth the language and cultural position assumed for the prehistoric Indo-Europeans, is the probable ancestral home of the majority of civilized peoples.

Professor Bender does not ignore the contribution of archeology and anthropology to the body of knowledge concerning the Indo-Europeans, but the part of philology's sister sciences is slight in this determination of our heredity. Philology becomes a vital power; archeology and anthropology may be guided by it and their investigations sustain and confirm the position of philology on this question. We are indebted to Professor Bender for the best English presentation of philology's important contribution to the solution of the problem; its services in helping to reconstruct the history of the past determine the place of linguistic science as an efficient ancillary of philosophy in explaining the meaning of the present.

INTELLIGENCE AND RACE

A REVIEW OF SOME OF THE RESULTS OF THE ARMY INTELLIGENCE TESTS

I. Foreign-born

PAUL POPENOE

Coachella, California

OF THE American army raised during the Great War, something like one-sixth was foreign-born. Mental tests, given to nearly 2,000,000 soldiers,[1] bring out some highly interesting and significant differences between these foreign-born and the native-born Americans; and also between various parts of the foreign-born contingent. A few of these findings of particular eugenic interest are noted in the present paper.

For statistical analysis, the psychological members of the Surgeon General's staff who had the work in charge, took a sample of about 94,000 men of the white draft, this being as large a number of records as could be successfully handled with the means at their disposal. Of these 94,000, approximately 13,200 reported that they had been born in a foreign country. Different nations were represented in widely varying degrees, many countries having only a few hundred men in the list, while Russia was responsible for over 2,300 and Italy for more than 4,000.

Figure 11 shows the average mental age of the representatives of each country which had more than 100 men in the sample. For comparison, the graph includes the average of the white officers (who with few exceptions were native-born Americans); the average of the white draft, including the foreign-born section; and, finally, the average of the negro draft, which is almost wholly native-born American.

If a mental age of 20 years be taken as the point attained by a very intelligent adult, and 16 years as the average normal adult of white American stock,[2] the relative standing of the various groups is at once apparent. The officers form a group better than the average, as one would expect, since some mental superiority is necessary to enable one to discharge the duties and responsibilities attached to a commission.

The Canadian contingent probably differs little in racial antecedents from the bulk of the old white American stock; and its average age of 13.29 years is not greatly different from that which the whole white draft would show, if the foreign-born elements were subtracted from it. For the present purpose, it would perhaps not be far from right to class the Canadians as also native-born white Americans—as many of them in fact are.

Passing this group, the average soon begins to decline. Great Britain stands at 13 years—and the inclusion of the Irish in this classification tends to pull down this average, as will appear later. If Ireland were excluded, England and Scotland together would make much the same sort of showing that Canada does.

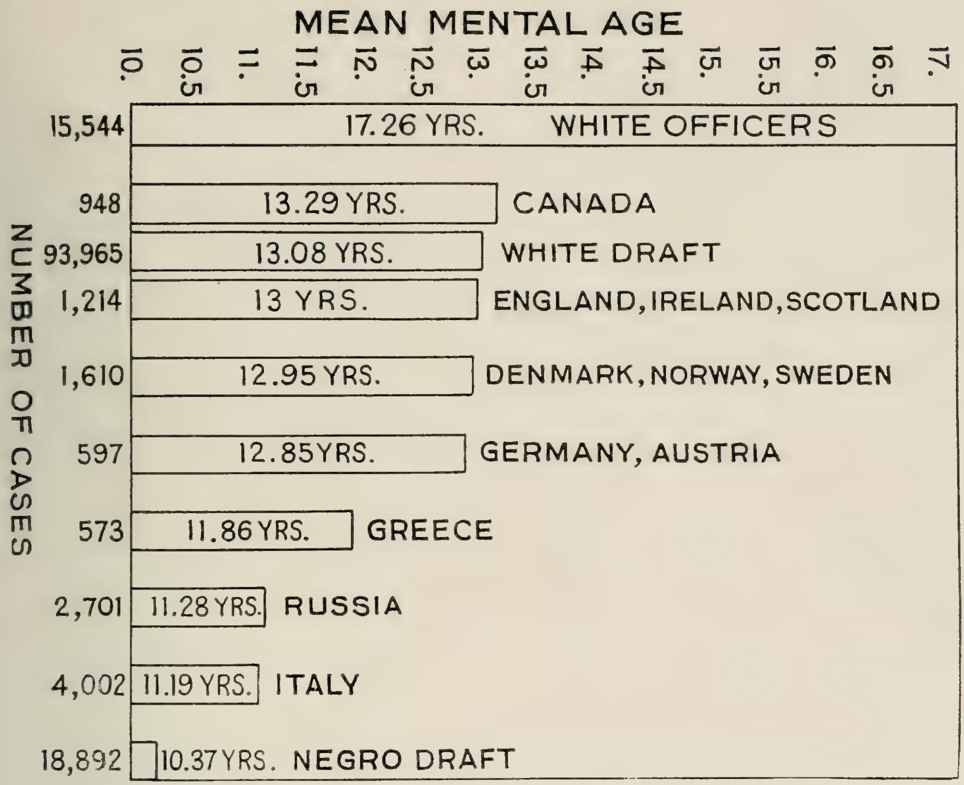
After the Scandinavian countries and the former "Central Empires," which are but little below the American average, the drop becomes rapid. The young men of Grecian birth measured below the average mentality of a 12-year-old American schoolboy; the larger contingents of Russia and Italy fall still farther, until the Italians are not far above the level (10.37 years) of the American negro, or of a white adult who is of "dull mentality."

[1] *Mem. Nat. Acad. Sci.* vol. XV, "Psychological Examining in the U. S. Army," ed. by Robert M. Yerkes. Pt. III, Chap. vi and vii. Washington, D. C., 1921.

[2] No particular dependence is placed on these standards, the validity of which has been challenged by various psychologists. They are taken merely for convenience of comparison, since the problem of the foreign born is essentially one of relative values.

THE BEST AND THE WORST OF THE LOT

FIGURE 10. In the above graph, the average age of mentality of the white male population of the United States is taken as zero; columns to the right of this line show the percentage of foreign-born draftees who were found to be above the American average, mentally; while the columns to the left of the line represent the percentage of the foreign born contingent who were below the average white American in intelligence. It is obvious that some of the countries responsible for most of the immigration in recent years are sending men who are almost all of inferior intelligence, as measured by existing American standards.



AVERAGE MENTAL AGES OF DRAFTED SOLDIERS

FIGURE 11. By psychological tests, the "mental age" of a man is measured in comparison with what is assumed to be the normal development of the mind. The above graph shows that, compared with the average (13.08 years) of the whole white draft, many of the men of foreign birth made surprisingly low scores; while the average adult negro showed only the intelligence of the average 10-year old white schoolboy.

These striking racial differences are brought out from a slightly different point of view in Fig. 10. Here the great bulk of the American nation is taken as the standard of division, and the graph shows, to the right of the dividing line, the percentage of soldiers above average mentality, and to the left of the line, those below the average white American mentality.

It is at once obvious that the number of superior men contributed by a country will not furnish a basis for predicting the number of inferiors furnished by that country. There is some correlation, however,—the amount was not measured. From a eugenic point of view, the contribution of superior individuals is in many ways more important to the nation than the number of inferior individuals sent over as immigrants: hence the countries have in this graph been ranked in proportion to the number of individuals of A or B mentality whom they contributed to this sample of the draft.

It is apparent that, aside from English-speaking countries, only Holland and Germany made contributions that averaged fairly well with the bulk of the American population. And worst of all, the proportion of immigrants from these countries during the last quarter of a century has been small. The great bulk of recent immigration to the United States has been made up of Slavic and Mediterranean peoples; and the startlingly inferior quality of these immigrants, from a psychological point of view, has rarely been more strikingly shown

than in these army returns. It is clear, as special students of immigration have long asserted, that the South Italians,[3] Poles, and Russians who have been imported in such large quantities during the past few decades, to furnish American industry with cheap manual labor, represent an extremely inferior racial contribution, measured by existing American standards.

It is not intended to suggest that the immigrants, here described, are fairly representative of their parent populations. It is probable that they are not: but such an admission does not mitigate the seriousness of the situation, eugenically. Whether the United States has become the dumping ground for the representative individuals of an inferior nation, or for the dregs of a superior nation, the effect on this side of the Atlantic is equally unfortunate.

As the figures on which some of these averages are based are small, amounting in the cases of Holland and Belgium to little more than a hundred each, it would be a mistake to lay too much stress on the exact ranking given. But if only the broad general outlines are considered, it cannot be believed that multiplying the data a hundredfold would alter the situation. It is not conceivable that the predominantly Nordic countries, which now stand at the head of the list, would be displaced by the Slavs and Latins who stand so far down at the foot.

It would be interesting to know how far the contingent ascribed to Russia represents Russian Jews. Presumably a large part of it must be made up of the Russian Jewish immigration of the last 30 years. It has often been assumed that the Jews as a race are superior to the average in intelligence. If such an assumption were verifiable in these figures, it would leave the non-Jewish Russians in this contingent in a highly unfavorable light.

Of the foreign-born draftees here studied, approximately 70% had come to the United States within 10 years of registration. When the foreign-born were divided into classes, depending on the length of time they had been in this country, it was found that apparently "the group that has been longer resident in this country does somewhat better in intelligence examinations."

This might be interpreted in a number of ways—evidence on all of them being lacking. It might be that the more intelligent immigrants succeed and therefore remain here while the failures go back home. But since some of the successful immigrants, those who make money, also return home, this hypothesis is uncertain.

Again, it might be that longer residence means greater familiarity with the English language, and hence greater success in the tests. This is largely negatived by the fact that a large proportion of the foreign-born—namely, all those who seemed to require it—were given special tests which were little dependent on the ability to understand English.

Or it may be that the more intelligent young immigrants were those who, in 1914 or shortly thereafter, voluntarily went back to their old homes to answer the call to arms. This may account in some small degree for the observed differences.

But when all considerations are balanced, it seems to me likely *a priori*, that the difference here shown is to a marked extent one of difference in the inherent quality of the immigrants. There are many independent grounds for reaching the conclusion which these figures suggest, that the quality of immigrants to the United States has become poorer, year after year. The first tide of Russian exiles, who came to the "land of the free"

[3] The low standard of recent Italian immigrants, here shown, is not a novel finding: it is confirmed by other investigators. See for example the figures published by A. H. Arlitt (in McDougall, W., *Is America Safe for Democracy?*, pp. 63-4, N. Y., 1921) and by L. M. Terman, in *The Intelligence of School Children*, p. 56, N. Y., 1919. In Miss Arlitt's study, all American school children grouped together gave an I. Q. of 106, while the Italians gave 84 and Negroes (mulattoes?) 83. Dr. Terman's figures are almost identical.

in the '80's, is generally considered to have been better than the average who remained behind. It is not likely that the Russian Jews of 1880–90 could have yielded any such figure as is here shown for Russians of the draft army in general.

Admittedly, the draft figures do not lend themselves in most instances to a detailed and refined analysis. For the present purpose it is not at all necessary that they should. Their general trend is clear, inescapable, and incontrovertible. It shows in a most striking way that the average of American immigrants during the last quarter of a century is below that of the native-born white population; and that the average of the countries which are sending over most of the immigrants, is even lower still. This last average is, indeed, so deplorably low that it is a fair and serious question whether the United States can eugenically afford to admit any more such average immigrants, either without any restriction, or on a percentage basis. Should not the American policy be that of admitting all who are superior to the American average, and no others?

MANY-NODED DWARF BARLEY

Harry V. Harlan and Merritt N. Pope
Office of Cereal Investigations, U. S. Department of Agriculture, Washington, D. C.

A BARLEY plant having a large number of extremely short internodes and an abundance of fine leaves was found at Aberdeen, Idaho, in the summer of 1918. It occurred in Mesa, C. I. No. 1313, an agricultural variety of *Hordeum distichon nudum*. This plant, which was very short, developed much more slowly than its neighbors, but by August 4 a single fertile slightly modified spike of nearly normal size had emerged, together with about 6 other greatly modified spikes. It was necessary to harvest the plant on this date, although the foliage was still green.

This aberrant plant (Fig. 12) which was grown under irrigation, measures about 50 centimeters from the crown to the tip of the awns. Many of the culms are branched near the base. As nearly as can easily be determined there are 17 culms, divided into 28 branches. In the original plant all the culms have more than the normal number of nodes, and roots are found on the second nodes above the crown. The spike of the original plant shown in Figure 12 is borne upon a culm having about 12 nodes. The internodes, in general, become successively shorter toward the apex of the culm and merge into the rachis of the spike. The three lowest nodes of this spike threw off branches in place of groups of spikelets and the long intervening internodes exhibit the zigzag appearance characteristic of the lower part of the rachis of this strain. The remaining culms have many more nodes, the maximum being at least 20.

In the fall of 1918, one seed was sown in the greenhouse at Arlington Farm at Rosslyn, Va. This germinated and the resulting plant produced a number of greatly modified spikes which, in June, 1919, yielded a few seeds to add to the small original stock. The plant grew very slowly and was much taller than its parent. With the increase in height was an increase in the number of nodes, of which there were 20 to 25 on the average culm. In 1920, plants grown in the greenhouse again were very tall and again produced only greatly modified spikes. Some of the culms reached

THE ORIGINAL DWARF PLANT

FIGURE 12. The dwarf measures about 50 cm. from crown to tip of awns; the parent measures about 95 cm. There are seventeen culms divided into twenty-eight branches. (See text, p. 269.)

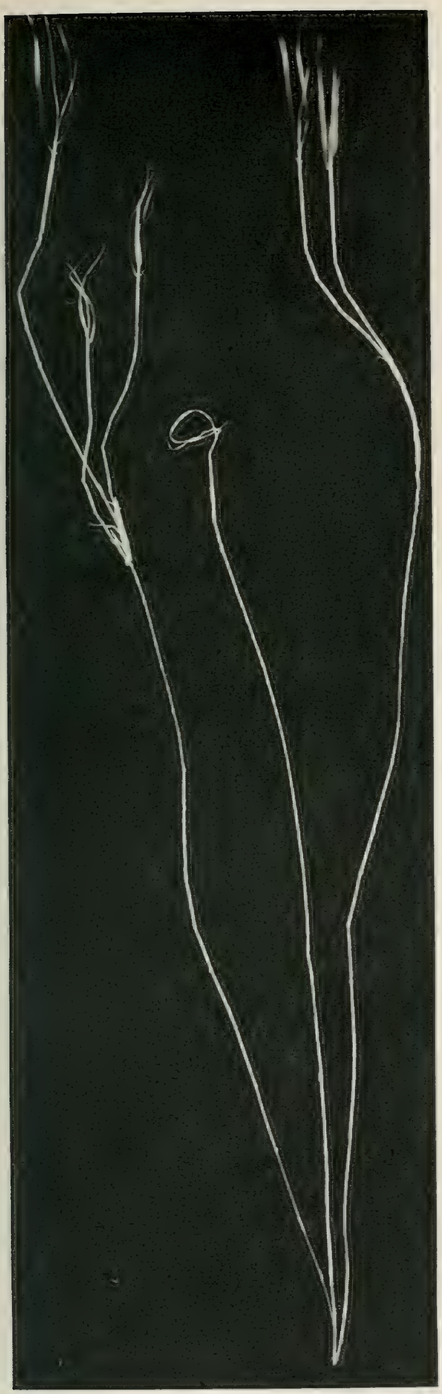
a height of 125 centimeters and possessed over 50 nodes. The greater lengths came from the development of vegetative branches on the inflorescence. These inflorescences often produced no fertile flowers, while frequently one or more vegetative branches at the lower nodes of the modified rachis developed into a culm similar to the original one. There is a gradual transformation of culm to rachis and of vegetative leaves to floral leaves, which it is the intention of the writers to discuss in a later paper.

One of the longer culms is unbranched for 82 centimeters and has internodal lengths ranging from 5 to 7 centimeters near the crown to 1.5 to 2.5 centimeters near the first inflorescence. One of the vegetative branches of this inflorescence is 35 centimeters long and has 29 nodes to the base of the second inflorescence. Many of these vegetative branches remained green and actively growing after the culm below had turned brown. Many attempts at crossing these greenhouse plants were made, but due to the absence of the near-normal spikes on greenhouse plants, little success attended these efforts.

Figure 13 shows a second portion of the plant with the leaves removed to show the branching which sometimes occurs at an inflorescence. Proliferations are to be seen on two of the branches. Figure 14 shows one of the modified spikes from a greenhouse plant.

Two seeds were sown in the nursery at Aberdeen, Idaho, in 1919. Both germinated and produced many-noded plants which again were only about 50 cms. tall. These plants produced many abnormal spikes containing a few seeds and two or three rather small spikes of nearly normal appearance. The culms which bore the more nearly normal spikes had fewer nodes and a much more nearly normal appearance than the others.

At Aberdeen, in 1920, plants of this dwarf form were grown which produced several nearly normal heads, and hybrids with several different varieties of barley were made successfully. In



BRANCHING AT INFLORESCENCE

FIGURE 13. In this case, branches have developed at the inflorescence. These inflorescences often produced no fertile flowers and the vegetative branches often grew to considerable length and remained green long after the remainder of the plant had turned brown.

A MODIFIED SPIKE

FIGURE 14. Great variation in the extent of abnormality of the spikes was found. In the extreme cases branches were given off at the nodes instead of spikelets; others were nearly normal. Very little seed was produced by the greatly modified spikes.

PARENT FORMS AND FIRST GENERATION HYBRIDS WITH THE DWARF BARLEY

FIGURE 15. The two parent forms on the left are Nepal and Manchuria. The type of heads obtained by crossing these two species with the dwarf form are shown on the right. No "dwarf" characteristics are found in the first generation, but in the second generation segregation of normal and dwarf forms occurred in a ratio of approximately three to one, indicating that the dwarf character is a Mendelian recessive.

1921 the Aberdeen "dwarfs" were again typical of the dwarf plants as grown outdoors in summer. One of these had 26 culms about 60 cm. long and having 12–18 nodes, and on the same plant were found 5 culms which seemed normal. None of the latter possessed more than 6 nodes above the crown, the longest was 92 cm. in height, and all five had nearly normal spikes.

The crosses were made in 1920 upon 4 varieties, as shown in Table I.

The crossed seed was grown in the greenhouse at Arlington Farm in the following winter and the F_1 heads shown in Figure 15 were obtained. No "dwarf" characteristics were found in the plants bearing these heads. The F_2 seeds from these heads were sown at Aberdeen in 1921 and produced populations which segregated for type of plant as shown in Table II.

In the Utah Winter cross, the winter plants cannot be accurately classified because of late maturity. Considering the small numbers used, the ratios obtained are in fair accordance with the expectation on a basis of a 3:1 ratio, showing the segregation of a Mendelian recessive.

Few dwarf plants have been reported in barley. Bungo Miyazama[1] reports the finding of dwarf forms in the back-cross upon Golden Melon by an F_1 plant, the offspring of a cross between Golden Melon and the Japanese variety, Sekitori. This dwarf was heterozygous, breaking up into normals of the parental types and a still more dwarfed type in the ratio of 1:2:1. Neither of these dwarfs was at all like the one here discussed. Vestergaard[2] reports finding 3 dwarf-like variants in an otherwise constant line of 2-rowed barley. When crossed with Binder barley, of the 95 individuals, constituting the F_2 progeny, 81 were normal and 14 dwarf, giving a ratio of 6:1. The dwarf is not described.

In February, 1922, Dr. K. F. Kellerman, Associate Chief of the Bureau of Plant Industry, called the attention of the writers to a dwarf form of *Hordeum vulgare pallidum* which he had received from Mr. J. M. Mack of Fallbrook, Cal. Mr. Mack stated that he had discovered the type in a field two years previously. This dwarf is apparently the same type of variation as that found by the writers, but in a 6-rowed hulled barley, while that found at Aberdeen was in a 2-rowed naked barley. The double appearance of this variation seems to have one plausible explanation, namely, that it is a mutation where all the modifications which occur in the plant are caused by the same factor.

Hor[3] describes what is undoubtedly the same barley as that received through Dr. Kellerman.

TABLE I. *Data Regarding Barley Varieties Crossed with the Dwarf Form*

Baku,	*H. dis. nudum,*	2-rowed, bearded, naked (parental type of "dwarf").
Manchuria,	*H. v. pallidum,*	lax 6-rowed, hulled, bearded.
Utah Winter,	*H. v. pallidum pyramidatum,*	very dense, 6-rowed, hulled, bearded, winter habit.
Nepal,	*H. v. trifurcatum,*	6 rowed, naked, hooded.

TABLE II. *Segregation of F_2 Generation of Dwarf Barley Crosses*

Parentage	Normal	Dwarf	Ratio
Dwarf×Baku	45	14	3.21:1
Dwarf×Manchuria	49	17	2.88:1
Dwarf×Utah Winter[a]	39	8	4.88:1
Dwarf×Nepal	48	13	3.69:1
Total	181	52	3.48:1

[a] In addition to the 39 normal and 8 dwarf plants, there were 5 winter plants which could not be classified.

[1] *Jour. Genetics,* 11:205-208, 1922.
[2] *Tidssk. Planteavl.,* 26:491-510, 1919.
[3] *Science,* Vol. LV, No. 1423, April 9, 1922.

TALKING DOGS

IN HIS article on "Prehistoric Telephone Days," that appeared in the National Geographic Magazine shortly before his death, Dr. Alexander Graham Bell mentioned his early efforts to teach dogs to talk. He received two letters about talking dogs from people who have been more successful, and they have an added interest at the present time. Perhaps someone will be inspired by these pioneer successes to develop a race of talking dogs by the selection of a strain with unusual linguistic ability. It has been suggested that the development of a race of unusually appreciative owners would also be necessary.

Anyone who has owned an intelligent dog or horse knows that man's best animal friends all but talk. They can express a great variety of emotions and ideas without the use of spoken words, so that it is but a step to the use of the more convenient method of vocal expression. EDITOR.

Toronto, Canada,
May 17, 1922.

My dear Dr. Bell,

A few days ago a copy of "The National Geographic Magazine" was sent to me by some friends in Ottawa, who, having read the paragraph on teaching a dog to speak from your article "Prehistoric Telephone Days," were very anxious that I should write and tell you about a rather extraordinary dog of mine.

He is a black Spaniel, which I rescued one day some seven years ago, and ever since he has looked upon me as his special property and charge.

As he is extremely fond of anything to eat, he always made the most terrific noises in his throat when sitting up to beg, keeping this up until he got what he wanted. Then one day, so clearly that everyone in the room recognized it, he made a sound which distinctly was, "Jus' a crumb," rolling the "r" in the crumb like a perfect little Frenchman. His name just happens to be "Noieand."

We all made a tremendous fuss over him, gave him what he wanted, then offered him something else to see if he could do it again. He carried on in this way for about two months, sometimes he would say it and sometimes he wouldn't, but whenever he did he got his "Crumb," likewise a great deal of fussing and petting.

At the end of about two months he began to realize, that this noise brought him whatever he wanted, and of his own accord would come running out the room, sit up on his little hind legs and say "Jus' a Crumb" over and over again, sometimes if he were excited, adding "a crumb, a crumb" at the end. He did this the first time when we gave him some maple syrup on bread, he thought he was just getting plain bread, and when he tasted the maple syrup, swallowed it whole jumped up on his hind legs and positively screamed "Jus' a Crumb, a crumb, a crumb, a crumb, a crumb," four times.

Very often in the afternoon, after the tea things have been carried out of the dining-room, we hear the little speech being made, and looking into the room, we see him sitting with his nose just on a level and about three inches removed from the second shelf of the curate talking away in the hope that someone will give him a crumb. He is really very honorable and would never touch anything as was proved on one occasion when he was shut up in a room for two hours with a plate which had three little cakes on it and which someone had left on a chair just the height of his nose. He was lying down beside the chair when I went in, but as soon as he saw me, jumped up and started saying what he wanted.

We notice that when he makes the noises which form this phrase, he rolls his tongue up over his nose, and the further up he rolls it the more distinct the words.

My Aunt, "Marshall Saunders," the author of "Beautiful Joe," who is of

course a great lover of animals and has studied them all her life, was told of this and believed it in a sort of way, but allowed rather a lot for our imaginations. In one of her later books she brings it in, but as soon as I read it, I knew she didn't realize just how phenomenal it was, so we insisted that she come and visit us as soon as possible.

When she did she was absolutely dumb-founded, and could hardly believe that it was Noieand who said it.

On different occasions also, when father brought out-of-town men home to dinner, their amazement has been quite funny to watch, unfortunately for them, they go home telling of this talking dog and as one poor man from the west told father, "Liar" was mild to what they called him, and it has been suggested that I ought to take my dog and make a tour of the West to redeem reputations lost on his account. As for myself, I have learned never to tell the story unless my old dog is with me. It is only after reading your article that I have the courage to tell you, but having read it, I feel that you will realize such a thing is possible, and I should so like if ever you are in Ottawa, where I live, (I am just in Toronto during the school terms) to have you come and see my dog. You can always find out where I am, or rather where Noieand is, from father, who is the Deputy Minister of Finance, anyone could direct you to his office, and I know if he thought you were interested, he would be only too pleased to have you see Noieand as he is just as proud of him as I am.

I do very much hope that sometime soon you will have occasion to visit Ottawa, I am

Yours very sincerely,
LAURA M. SAUNDERS.

Indianapolis, Indiana,
March 16, 1922.

Mr. Alexander Graham Bell,
1331 Connecticut Ave.,
Washington, D. C.
Dear Sir:—

I was very much interested in reading your article which appeared on page 34 of the Indianapolis Sunday Star, Mar. 12, 1922, concerning your efforts to teach a dog to talk.

My reason for writing you is to tell you that we have a female Boston Terrier now past six years old, that for about the last three years or more, has been saying a few words. This dog answers to the name of "Smarty." Without any assistance, other than being spoken to, she can plainly and distinctly utter the word "Now"; sometimes repeating it, in answer to the question, "When do you want it," and saying, "Now-now," or "Now-now-now." Without much imagination, you can understand that she tries to say, "I want it now," "I want to go," and "Want corn."

She is unusually fond of corn-crisp or cracker-jack, which we tell her is corn. The word "Corn" is the most difficult for her of any she attempts to utter. She makes a very wonderful effort, however, by opening her mouth very wide as in a yawn, and expelling the sound at the same time.

We also have a French Poodle, and sometimes when "Smarty" is playing with this dog and becomes vexed with it, or sometimes when playing with a ball that happens to roll under any article of furniture, she will talk voluntarily to herself and say, "Now-now."

She is very fond of taking a walk in the evening, and has a few times when very anxious to go on one of these trips, uttered intelligently the words, "Go walk."

Trusting the above may be of some interest and pleasure to you and also that I may hear from you when convenient concerning same, I am

Yours very respectfully,
EMERSON BROCK.

Indianapolis, Indiana.
May 12, 1922.

Mr. Alexander Graham Bell,
1331 Connecticut Ave.,
Washington, D. C.
Dear Sir:—

Received your communication of March 23rd, in reply to my letter of March 16th, in which I told you of the

Boston Terrier dog and her utterance of a few words, without any assistance whatever.

As to any further explanation of how she came to utter the words which she does, believe it has been occasioned solely by her close association with myself and wife in the home from the time she was born, and also by the repeated coaching and constant repetition of us talking to her and urging her to say these words and at the same time encouraging her and telling her she could say it.

At the present time, she has gotten so that she will often attempt to say, purely of her own accord, without any coaching or speaking to whatever, "I want corn," and "I want it now," Also frequently when asked if she should like to take a walk of an evening, she makes a remarkable effort to say "I want to walk," or "Want to go."

Am merely telling you these things about her because you are interested in the matter, and not for any purpose of advertising the dog in any way whatever. As we would not think of selling her at all.

Am enclosing herewith a couple of kodak pictures which will give you a good idea of the actual appearance of the dog.

Yours very truly,

EMERSON BROCK.

A New Social Case-History Manual

The California Bureau of Juvenile Research, at the Whittier State School, which has been doing such increasingly useful work in sociological and psychological investigations since its development from a single survey in 1914, has issued a "Social Case History Manual" describing the methods now in use by the Bureau for studying individuals and families. The outline also serves as a guide for the training of social workers.

A good deal of highly significant work in social problems has been done at the Whittier School under the guidance of its Superintendent, Fred C. Nelles, and J. Harold Williams as Director, assisted by an able staff, and the methods developed through practice and study are very adequately and compactly presented in the manual referred to, which will be found a very useful part of the literature of social research workers.

VALUE OF THE HEMP PLANT FOR INVESTIGATING SEX INHERITANCE[1]

The Genus Cannabis Offers a Promising Field for Studying Sex Inheritance in Plants

WALTER SCOTT MALLOCH
University of Illinois, Urbana, Ill.

IN 1920 Professor E. B. Babcock called the attention of the genetic world to the need of corroborative evidence in establishing the far reaching conclusions presented by the Drosophila workers.[2] In discussing the desiderata of ideal material for genetic investigation the contrast between plant and animal life was pointed out. The merits and demerits of the genus Crepis were enumerated as an illustration of a favorable plant which could be used as a means of substantiating the chromosome theory of heredity. Having had the pleasure of observing Crepis under test both cytologically and genetically for several years at the University of California, the writer is in full accord with the statements made as to the promise and value of Crepis for genetic investigations.

Nevertheless, Crepis and most of our plants cannot be used to substantiate the manner of sex inheritance. The inheritance of sex in plants has been studied in Bryonia by Correns[3] and in Lychnis by Shull.[4] It is the purpose of this article to present certain observations in connection with the habits of *Cannabis sativa* (hemp) and to call attention to the merits of this plant as one particularly adapted for the investigation of sex inheritance.

Hemp is commercially valuable both for its fiber and for a drug, *Cannabis indica* or *hashish*, Scientific investigations in hemp are thus worthy of support from agricultural institutions, from the commercial as well as from the scientific standpoint.

The genus Cannabis consists of a single species and belongs to the family Moraceae.[5] It is advantageous in genetic investigations to choose a genus having two or more species with the same chromosome number. In such cases one can compare the loci of the genes for similar characters in the two species upon the chromosome map. However, Humulus (hops) is a closely related taxonomic genus which may afford a basis for comparison. Cannabis has 10 haploid chromosomes while Humulus has 20.[6] This relationship has advantages as well as drawbacks but it is not prohibitive of certain comparative studies. The linear order of the genes in equivalent chromosomes cannot be compared but one may study the effect that the doubling of the chromosome number has upon

[1] A contribution from the Agronomy Plant Breeding Division, University of Illinois.

[2] BABCOCK, E. B. Crepis, A Promising Genus for Genetic Investigation. *American Naturalist* LIV: 270–276. 1920.

[3] BABCOCK AND CLAUSEN, *Genetics in Relation to Agriculture.* McGraw-Hill Book Company Inc. 1918.

[4] SHULL, G. H. Sex Limited Inheritance in *Lychnis dioica. Zeit. Abst. Vererb.* XII.

[5] KRAEMER, H. *Applied and Economic Botany.* p. 513.

- BAILEY, L. H. *Standard Cyclopedia of Horticulture.* p. 567. Macmillan and Co. New York. 1914.

[6] ISHIKAWA, M. A. A list of the Number of Chromosomes. *Bot. Mag. Tokyo* 30: 420–448. 1916.

GROWTH CONTROLLED BY SIZE OF POT

FIGURE 16. Two plants of the variety Kymington grown under identical conditions except that one was in a four-gallon, the other in an eight-gallon pot. Although the rate of growth is directly dependent on the size of the pot, the time required for the plants to flower is practically the same in all cases.

BRANCH OF A FEMALE PLANT

FIGURE 17. The genus, Cannabis, to which hemp belongs consists of a single species. It belongs to the Mulberry family and hops is the nearest related genus. This is a disadvantage, genetically, as it is desirable to have two rather closely related species, having the same chromosome number.

the distribution of characters in the chromosome groups. The chromosome number in Cannabis is somewhat larger than in *Drosophila melanogaster* and *Crepis virens* but it has the same number as *Zea maize* (corn). A low chromosome number facilitates the isolation of linkage groups but a high chromosome number does not prevent the discovery of linkage relationships. Woodworth[7] has isolated four linkage groups in *Soja max* which has about 20 haploid chromosomes, and at least 6 linkage groups have been found in corn. It would appear, then, that it is possible to analyze and locate groups of factors corresponding to the different chromosomes where the haploid number is as high as ten.

Hemp is a dioecious plant reaching a height of eight to twelve feet under favorable environmental conditions. Their development under greenhouse conditions at Urbana, Illinois, was found to be definitely controlled by the size of the pots in which they were grown. Those in 8-gallon pots were from eight to ten feet in height, and averaged two to three feet taller than the plants grown in pots half that size. The taller plants were more robust than the smaller ones but all

[7] WOODWORTH, C. M. Inheritance Studies in Soybeans. I. Cotyledon, Seed-coat; Hilum, and Pubescence colors. *Genetics*, VI.

MALE AND FEMALE FLOWERS OF HEMP

FIGURE 18. Pendent stamens can be seen in some of the male flowers (left), while the protruding stigmas are visible in nearly all of the female flowers.

The dioecism of hemp greatly simplifies the technique of experimental pollination, as it eliminates the necessity of emasculating the flowers. It is more difficult to establish genetically pure strains of a dioecious plant than of one that can be self-fertilized, and it is impossible to establish a pure line in the strict sense of the term.

fruited at about the same time. Seed sown during the fall and winter months produced shorter and more slender plants that fruited in a much less time than the summer plantings. Plants from seed sown in August, and those from seed sown in December both fruited in March.

These observations illustrate in a general way the influence of environmental conditions upon the growth of hemp. The lack of critical tests is recognized by the writer but the differences were very striking and were noticed at once by casual visitors not engaged in scientific investigations. The relationship between size of plant and size of jar is not of universal occurrence and is of considerable interest from this standpoint. While most plants show some reaction to the amount of space available for root development, they do not all respond so distinctly as hemp. This relationship would enable us to control the size of plant desired by regulating the amount of root space available. The plants in the greenhouse were easily grown, thrifty, vigorous, and free from destructive disease and insect enemies.

The dioecious nature of hemp is of considerable advantage in that it eliminates the labor involved in emasculation. This manipulation requires considerable time in certain plants like barley, but demands relatively little effort in other forms such as tobacco. In working with a dioecious plant one is at a disadvantage in

GENERAL VIEW OF GREENHOUSE CULTURE OF HEMP PLANTS

FIGURE 19. Even at this early stage some of the plants have begun to flower, but none set seed until a much later date. The female plants flower best at a temperature of 85° Fahrenheit, while the male plants produce flowers at a much lower temperature, about 60°. It is not absolutely necessary to have a greenhouse for experiments with hemp, as it grows well out of doors, but it is possible to raise two generations a year in the greenhouse.

attempting to establish homozygous strains. It is, of course, impossible to establish in hemp a pure line according to the strict definition given by Johannsen. There is no reason, however, why homozygous strains, similar to those in Drosophila cannot be established in the course of time. The long life-cycle of hemp is a serious drawback but this plant is no more undesirable in this respect than Zea and Nicotiana which have furnished the material for investigations leading to some of our most valuable genetic hypotheses. Since hemp is adapted to greenhouse conditions it has an advantage over corn, and it might be possible to obtain two generations a year by proper regulation of food and temperature conditions.

The staminate flowers occur in axillary panicles as illustrated in Figure 18. Hemp compares very favorably with corn in the quantity of pollen produced. A slightly disturbed male plant in full flower liberates a great shower of pollen sufficient to pollinate many female plants. This characteristic is of great value in hybridization because the same male parent can be used in a number of crosses.

The pistillate flowers are borne in short spikes, a single seed being produced by each flower. A cluster of female flowers is illustrated in Figure 18. The female plants branch considerably (Fig. 17) when grown under favorable environmental conditions and will produce over 1,000 seeds. The branching habit facilitates brother and sister mating as well as varietal crossing upon the same plant. The large number of seeds provides ample numbers for testing different genetic ratios. In order to hasten the production of female flowers the temperature should be kept around 85 degrees Fahrenheit. Male flowers are produced at a much lower temperature, averaging around 60 degrees Fahrenheit. At this temperature the male plants continue to flower for several months so that no difficulty is experienced in obtaining male and female flowers at the same time.

One of the desiderata of ideal genetic material is the facility with which one may hybridize different strains. The fruiting branch apparently does not flourish when enclosed in tight paper bags (Fig. 19) so it would appear that a closely woven cloth tent is desirable for this type of work. One meets a handicap here in securing sufficient funds for the purchase of such material. I have already called attention to the fact that hemp is a suitable greenhouse plant and thus a genetic investigation in hemp can be conducted both indoors and in the field where climatic conditions favor this procedure. In case

A SIMPLE-LEAVED MUTATION

FIGURE 20. Compare the simple leaves of this plant with the palmately cleft leaves shown in Figures 17 and 21.

This mutation appeared in a strain of the Ferramington variety. The leaflets of the normal digitate leaves appear to have grown together, as the normal number of midribs is present and the usual number of lobes. (See text, p. 282.)

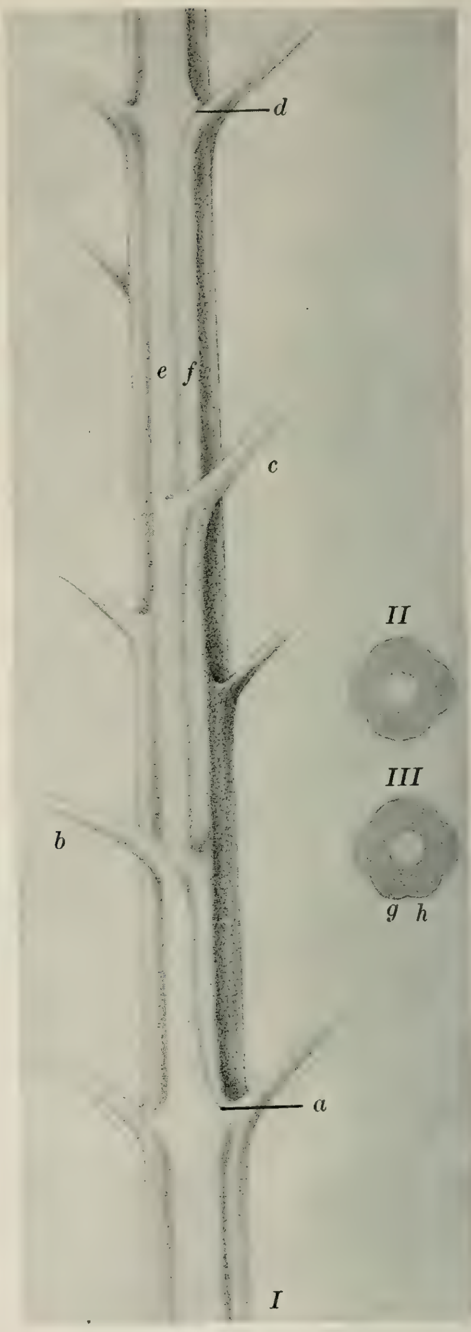
proper greenhouse facilities are not available, the investigation can be conducted entirely in the field without any greater loss of time than if plants like corn and tobacco were used. Sufficient cloth tents would be necessary both in the field and in the greenhouse. Genetic investigations with hemp are somewhat out of the question, then, unless sufficient funds are available.

"Variation is at once the hope and despair of the breeder," but a large number of sharply segregating characters are the hope and not the despair of the geneticist. Drosophila investigators have found that flies trapped in the open are largely of the normal wild form and that new characters are discovered through inbreeding and hybridization. The discovery of the present multiplicity of forms in *Zea maize* has been the result of careful observation and experimentation. In an obligatory cross-fertilized genus like Cannabis we would naturally

A SECTORIAL CHIMERA

Figure 21. A plant of the variety Tochigi was found in which several leaves were half green and half yellow. All these leaves were on the same side of the stem. Normally the stem has four ribs, as shown at II, Figure 22, but in the region of the chimera, one of the ribs was split and one half of the rib was green, the other yellow. (See text, p. 283.)

expect new forms to appear as a result of inbreeding. A mutant form was sent to the writer by Mr. L. H. Dewey of the United States Department of Agriculture and Professor A. H. Wright of the University of Wisconsin. This mutant is a simple leafed form which appeared in a strain of Ferramington. Instead of having the normal digitate leaf usually found in hemp, the mutant is characterized by a palmately cleft leaf as shown in Figure 20. The leaflets of the normal digitate leaf appear to have grown together as the normal number of midribs is present with an equal number of lobes. There is usually an unequal growth of tissue between the



STEM OF THE CHIMERA

Figure 22. a, d, beginning and end of divided rib; b, c, first and second chimera leaf; e, green half of rib; f, yellow half of rib; II, normal stem; III, stem in region of chimera; g, green rib; h, yellow rib.

midribs which results in excess leaf surface thus causing a folded and wavy appearance of the leaf.

The writer discovered a leaf and stem chimera in a male plant belonging to the variety Tochigi. The stem of hemp is four-angled with four distinct ribs. The lower leaves are opposite, a leaf arising from opposite ribs. On the particular plant under observation one of the four ribs was divided with a distinct depression between the divided strands for a distance including five series of leaves. The mutation arose in an intervening rib between two opposite leaves and ended in the same fashion (See Fig. 21). One-half of the divided rib was normal green while the other half was near "Martius Yellow."[8] Whenever a leaf arose from this divided rib, one half of the leaf and petiole was normal green, while the other half was "Martius Yellow." As hemp usually has an odd number of leaflets the middle leaflet was half green and half "Martius Yellow." The flowers arising on the normal side were of the normal type, while those arising on the abnormal side were "Martius Yellow" in color. The yellow flowers failed to open in this particular instance but were normal in all other respects.

This is clearly a sectorial chimera and further illustrates the possibility of obtaining new characters in hemp. Cannabis also exhibits differences in size characters and in seed coat shades.

Pritchard[9] and Schaffner[10] have shown that there is considerable variation in the sexual expression of hemp under certain environmental conditions. Pritchard obtained reversal of sex on both male and female plants by the removal of a certain number of flowers. Pritchard supports the hypotheses of Darwin and Strassburger in that both males and females are supposed to be potential hermaphrodites.

Schaffner observed teratological flowers and complete sexual reversal when the plants were grown on shallow benches in the greenhouse with low light intensity. This phenomenon was not found in my cultures due perhaps to better environmental conditions. Schaffner states that "sexuality is a state or condition not Mendelian in nature, but related to the functional activity of the plant and profoundly influenced by the environment." The statement is also made that "the ratio between carpellate and staminate individuals is about 1 : 1 with a large deviation in either direction for various plots." The equality of sexes was also found by the writer in the present observation. Unless some other plausible hypothesis can be offered to explain the equality of sexes, we are justified in accepting the Mendelian theory as the most probable basis for this phenomenon. The factor of nutrition can hardly furnish a mechanism for the equal distribution of sexes under normal environmental conditions.

The reversal of sex in hemp is an extremely interesting and important observation and it calls to mind the cases of the abnormal abdomen in Drosophila and the red flowered Primula. The cytologist has yet to determine what the germinal basis is for the sexual dimorphism exhibited by hemp and it remains for the geneticist to establish the genetic nature of this extreme range of character expression.

[8] RIDGWAY, R. *Color Standards and Nomenclature.* Published by the author, Washington, D. C. 1912.

[9] PRITCHARD, F. J. Change of Sex in Hemp. *Journal of Heredity* VII: 325–329. 1916.

[10] SCHAFFNER, J. H. Influence of Environment on Sexual Expression in Hemp. *Botanical Gazette* XVII: 197–219. 1921.

A VARIATION IN THE DOWNING GOOSEBERRY

On a recent trip to northern Ohio my attention was called to certain gooseberry plants growing in a plantation of Downing. The general aspect of these plants and their fruit was not dissimilar to that of Downing but a closer examination revealed the difference in foliage shown in the illustration. The normal form has leaves nearly as broad as they are long, while the aberrant plants have long narrow leaves. This difference in foliage seems always to be associated with complete, or nearly complete barrenness. The owner thought that the plants changed from one form to the other, but his son was of the opinion that both forms existed in the nursery stock. The one theory suggests the possibility of an obscure disease in the nursery similar to the "reversion" of black currants described in English publications. The other brings in the possibility of a spurious strain or variety, possibly like the off-type lemon trees found by Shamel in his citrus work. PAUL THAYER.

ARE ANY SPECIES UNIFORM?

Or Should the Assumption of "Pure" Species be Discarded and Diversity Recognized as the Normal Evolutionary Condition?

O. F. Cook

U. S. Department of Agriculture, Washington, D. C.

An address by Professor Bradley Moore Davis on "Species, Pure and Impure," published in Science for February 3, 1922, presents the case of "impure" species very effectively, while the "pure" species are treated only by definitions that lead, as Professor Davis says, to "what is almost an abstraction." That so little should be said of the "pure" species appears the more significant if we consider that species are not merely definitions or abstract assumptions, but natural groups of organic individuals, affording the veritable subject-matter of the biological sciences.

Species are maintained by processes of sexual reproduction, with continual crossing of the individual lines of descent, so that each species forms a network of lines of descent. The question of uniformity bears upon the nature of the specific network. Are there reasons for assuming that members of the same species are uniform, identical or homozygous? Or should we think of the members of species as normally diverse, with multifarious germinal constitutions represented among the different individuals and lines of descent that are woven together?

THE NETWORK OF DESCENT

The network of descent is not to be dismissed as an abstraction or mere figure of speech. Though more difficult to describe or to define by arbitrary standards, the species as a whole is not less real than the individual "lines" of descent that are followed in genetic or genealogical studies. It is usual to deal with separately propagated lines in the study of inheritance of particular characters, or for agricultural purposes, but an individual line of descent does not constitute a species. We get only partial views of heredity and evolution if the coherent, reticular constitution of species, the normal condition of crossing and weaving together of the different individual lines of descent, is left out of account. Our understanding of species governs inevitably our interpretation of the nature and causes of evolution. To think clearly about evolution is essential to constructive investigation, as well as to the development of practical applications of biology.

There would seem to be no doubt of the existence of diverse, heterozygous, or "impure," species, as Professor Davis calls them. The doubt is whether there are any "pure," uniform, species, or any tangible reasons for maintaining the assumption of uniform species, if not supported by facts. Examples of identical germinal constitutions are found in twins and in plants propagated by cuttings or by self-fertilization, but these do not constitute species. Some investigators have believed in "pure lines" that would remain constant, but "mutations" continue to appear in self-fertilized or line-bred stocks. Even with vegetative propagation, definite differences arise through the "bud mutations" that are now known to occur in many plants. Mutation in parthenogenetic generations of aphids has also been announced recently.[1]

For purposes of description, species are supposed to be uniform, but taxonomic ideals of uniformity, however useful in the study of classification, should not be allowed to bring confusion into evolutionary ideas. The ob-

[1] Baker, A. C. *Journ. Washington Academy of Sciences*, 12:320.

jects and methods of taxonomy are entirely different from those of evolutionary and genetic study. Though taxonomists disregard individual diversities and seek for the most constant or general characters, the difficulty of finding definitely diagnostic differences is well known, and is a testimony that diversity is a normal and universal condition of species.

DIVERSITY UNIVERSALLY FOUND

Close and careful observation of any natural species shows not merely infinitesimal diversity, but appreciable heritable differences. The art of breeding improved varieties is based on the recognition of differences. Skill and practice may be necessary to detect differences readily in unfamiliar species, but persistent search is always rewarded. The diversity of the human species is our most familiar example. Other species appear more uniform because less familiar, but shepherds know their individual sheep, and garden experts see individual differences in plants. Many travellers have noted their first impression that native Africans, Malays, or Chinese, were all alike, and their later surprise in finding the same people as different individually as Europeans. The framing of definite race characters is as difficult as writing satisfactory diagnoses of species.

An ideal taxonomic character is one that is shared by all the members of a species, and is not shared by any other species. Such a character must have arisen in the species and become established through the whole network of descent. On the other hand, large numbers of hereditary differences exist as forms of diversity, without becoming standardized or established as uniform diagnostic characters of species, but continuing to appear as parallel variations in many related species, or even in distinct genera. Thus many species or genera may respond in the same way to natural selection as a standardizing agency, if any change of the environment gives a more definite survival value to a particular character or combination of characters already represented in the networks of descent. Cases of parallel development may be taken to prove that evolution is mechanically directed, but less confidence is placed in the theory of orthogenesis when account is taken of the frequency of parallel variations.

THE EXISTENCE OF UNIFORM SPECIES UNPROVED

To "prove" that no species is uniform, or "pure," is beyond the logical range, like other universal negatives. Though diversities have been found in thousands of species, there are thousands more that have not been inspected for diversity or bred artificially to see whether they are heterozygous or not. The custom of many writers is to treat differences as variations and assume environmental causes. Or genetic diversity may be recognized but confused with hybridism. Tendencies to vary may be admitted, but uniformity claimed as a result of natural selection. According to a recent paper by Professor Osborn, " . . . Nature is constantly standardizing her machines through individual competition and producing flocks of birds and shoals of fishes which are so precisely alike that animals of the same age, sex, environment and heredity *show no perceptible variation* . . . " Thus the pure species assumption is carefully preserved, notwithstanding the confusion that it brings into general evolutionary ideas. Selection would need to be effective in rejecting all forms of diversity, if it were to keep the members of species "precisely alike." But why should we invoke natural selection or any other agency to explain a condition of uniformity that probably does not exist, and certainly has not been demonstrated?

Evolution no doubt is controlled by natural selection, to the extent that the adaptive characters may be favored by restricting the non-adaptive, but the special Darwinian doctrine of natural selection as the cause and explanation

of evolution is largely discredited. Changes are not confined to useful characters. Many useless, non-adaptive differences are developed, and useful features are specialized beyond the point of utility. Even serious defects are transmitted in latent form, out of reach of natural selection, but adding to the complexity of descent. A tendency to spontaneous variation must be assumed, even in cases where characters are increased under artificial selection, as recognized by Castle.[2]

With a belief in normal uniformity accepted, it is logical to argue that changes in the characters of species must require external agencies of the environment or internal "mechanisms of heredity," and such external or internal "causes of evolution" continue to be sought by many investigators. A different conception of evolution, requiring no such assumptions of special causes or mechanisms, becomes possible when the diversity that seems everywhere to exist among the members of species is reckoned as a normal condition of heredity, and of evolutionary progress.[3]

THE EVOLUTION OF SPECIES

In order to think clearly and effectively about evolution we must form practical conceptions of the changes that go on in species, as representing the evolutionary process. Species do not differ as mutations or pure lines differ, but in more general and less definite ways, on account of individual diversity. Evolution is to be thought of not merely as change of individual characters, or of characters of individual lines of descent, but as change in characters of species, modifying eventually the whole network of descent so that the members of a species can be recognized as distinct from members of the nearest related species. When this stage has been reached, an evolution of "new" species has been accomplished, by a process as gradual and indefinite but no less real than the development of a "new" language.

As a new word does not make a new language, so new characters do not constitute new species, unless the characters are preserved and established in networks of descent. Many writers go astray in assuming that evolution is merely originating new characters, or is some special form of character-origination, so that many scientific works do not convey a clear conception of the evolutionary process. Professor Bateson recently has misled Mr. Bryan into supposing that evolution is discredited in the scientific world. The mistake has arisen because both are looking for something that probably never occurs, and should not be expected to occur, a sudden transformation of one species into another. Darwin carefully considered and definitely rejected the idea of species originating abruptly, and this judgment rests as more firmly established by the efforts that have been made to displace it.

It is not in the nature of species as networks of descent to originate by definite, sudden changes of characters, just as it is not in the nature of languages to be formed or changed suddenly. The Latin language was not abruptly discarded or displaced in Italy, Spain, or France, but local forms of Latin developed gradually, and eventually were recognized as distinct languages. Mule-bred languages have been elaborated and "new plant creations" have been produced and propagated artificially, but such devices are in contrast with normal development. Diversity in words and forms of expression is universal in languages, like diversity of characters in species, and the relation of diversity to progress, in furnishing the material of continued evolutionary change, is a further analogy.

[2] *Journal of the Washington Academy of Sciences*, 7:387, June 19, 1917.

[3] Evolution not the Origin of Species, *Popular Science Monthly*, March 1904; The Nature of Evolution, *Science*, N. S., Sept. 7, 1906; Methods and Causes of Evolution, *Bul. 136*, Bureau of Plant Industry, October 1908; Pure Strains as Artifacts of Breeding, *The American Naturalist*, April 1909.

The most powerful educative agents of the vegetative apparatus of a human being are the other human beings around him, and they comprise the most powerful of the external effectors of education, for better, for worse. The training and education of the endocrine-vegetative system is the basis of all social rules (Habit, Custom, Law, Conscience). An unresolved discord, a continued conflict among the parts of the vegetative system, in spite of such education, is the foundation of the unhappiness of the acute and chronic misfits and maladjusted, the neurotic and the psychotic.

(Louis Berman, M.D., *the Glands Regulating personality*, p. 194)

Children Need Fathers

Is there any success that can pay a father for not knowing his child? If no amount of success could repay the child for neglect on the part of the mother, how much can make up for neglect on the part of the father? I have been teaching young men and women of college age for ten years and I am convinced that the greatest need of American children to-day is greater care from their fathers, greater feeling of responsibility for the upbringing of the children on the part of the fathers. A child needs a father's guidance just as much as a mother's. It is not a question of a mother's shielding the father and watching over the children while the father—free to forget them—makes name and fame. No. The best in both the father and mother should go into the care of the children. Then let him who can, make a career for himself "with equal rights for all and special privileges for none."

Louise Dudley, *The Atlantic Monthly*, June, 1922.

The Development of the Child

The Physical Growth of Children from Birth to Maturity, by Bird T. Baldwin. University of Iowa Studies in Child Welfare, Vol. I, No. 1, pp. 411, pub. by the University, Iowa City, 1921.

Here, in concise form, is a mass of well-digested material which must serve as a work of reference for all who are interested in the question, "How does a child grow?" The original data cover thousands of children; a series of easily compared tables gives certain facts about more than five million others; while an annotated bibliography of 911 titles puts the reader in touch with other authorities. The concepts of anatomical age and physiological age are developed in an interesting way. Little material bearing directly on problems of heredity is presented, but it is announced that special studies, covering all the members of certain families, are being made which will illustrate the parent-offspring correlation. The fraternal correlation is dealt with in this volume particularly in the cases of twins.—P.P.

The

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CONTENTS

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THE WALTZING RABBIT

FRONTISPIECE. One of *Waltzer's* ancestors was used in experiments to determine whether lead poisoning injures the germ plasm. Another was used in similar experiments in which alcohol was the toxic agent. Have these poisons permanently injured the germ plasm of this family of rabbits, causing the defective nervous system that characterizes *Waltzer* and some of his relatives, or has the inbreeding that has been practiced brought to light a latent defect of the germ plasm, as inbreeding often does? This is a question of very real importance to us as well as to the rabbits. If the lead used in many industries and the alcohol consumed by the opponents of the Eighteenth Amendment result in permanent injury to the race, it is something that every patriotic citizen, interested in the future of the nation, needs to know.

A WALTZING RABBIT[1]

LEON J. COLE AND DEWEY G. STEELE

Department of Genetics, Wisconsin Agricultural Experiment Station, Madison

AMONG a litter of four rabbits born February 14th, 1916, one later developed the habit of "waltzing" very much as is characteristic of the waltzing mouse. The peculiar actions of this animal were so pronounced and continuous as to attract the attention of all visitors. Darbishire early demonstrated the definite inheritance of this trait in the mouse, and when a similar condition was later discovered in rats by Bonhote,[2] this also was found to be inherited as a Mendelian recessive.

It at once became a matter of interest, therefore, to find whether we had another case of the same sort in rabbits. This led to a careful study of the pedigree of this individual for a clue as to how the trait may have originated, and to extensive breeding tests; but before giving these it will probably be best to describe more fully the individual himself and his behavior.

Waltzer, as he came to be called (or ♂ 301.3 of the records) was a strong, vigorous male of normal growth, but with a defective iris in the left eye and a tendency to carry the head turned a little to one side, the left. The iris of the left eye was incomplete on the lower side, making the pupil appear elongated vertically. It was probably the close approach of the pupil to the lower lid in this eye that gave it the appearance of always being partially closed (compare the two views, which show the right and left sides of the animal, respectively). In temperament *Waltzer* seemed more nervous than the average rabbit, and if disturbed or excited in any way would usually turn round and round in his pen in a narrow circle not much greater in diameter than the length of his body. He also often exhibited the circus movement of his own accord when not disturbed, but was able to hop ahead in a straight line when it seemed to suit his pleasure. When traveling directly in this way he did not exhibit the "wobbly" movements so characteristic of the waltzing mice. While he circled to the left (counter clockwise) much more often than to the right, he did, nevertheless, often turn in the other direction. This rabbit also frequently made a peculiar low grunting noise, different from any commonly made by rabbits.

Waltzer's Ancestors

The pedigree of *Waltzer* (Chart I) exhibits a number of points of considerable interest. Three generations back in his paternal lineage he traces to two original pure-bred Dutch-marked rabbits (♂ 14.1 and ♀ 15.1), purchased of a breeder who made a specialty of them. It is to be noted that the male (14.1) was used in connection with experiments on the effects of alcohol,[3] and is accordingly marked "alcoholized." Male 20.2, one

[1] Papers from the Department of Genetics, Wisconsin Agricultural Experiment Station, No. 37. Published with the approval of the Director of the Station.

[2] BONHOTE, J. LEWIS. On waltzing rats. *Proc. Zool. Soc. Lond.* 1912, pp. 6-7. It is of interest in the present connection to note Bonhote's report that "apart from the 'waltzing' character, three individuals were born blind, and in two of these cases the eyes were undeveloped and the optic nerve absent, and in addition many of the young that were reared were so weakly that they had to be killed, and others died before being weaned."

[3] COLE, L. J., and C. L. DAVIS. "The effect of alcohol on the male germ cells, studied by means of double matings." *Science* (N. S.), Vol. 39, No. 1004, pp. 476-77. 1914.

of the offspring of this original pair, was also used in an experiment in which poison was administered, this time in the form of lead acetate.[4] He finally died with symptoms of lead poisoning. The ancestry of the female, designated 1A (298.1), to which 20.2 was bred, is not accurately known, and the same is true of 3A (296.1) and 2A (297.1), which occur on the maternal side of *Waltzer's* pedigree. A number of young rabbits were discarded before being marked with ear tags, and these three were later returned to the breeding pens. There is much reason to believe that they are closely related to one another, possibly even being litter mates, and that they are all descended from ♂ 14.1. This presumption is based on color markings and other known facts, but the relationship cannot be asserted.

The mating of 20.2 and 1A (298.1) gave rise to 299.3, the father of *Waltzer,* who was, so far as the records show, an entirely normal rabbit. *Waltzer's* mother (274.6) was also normal, but her father, 3A (296.1), when about half grown acquired a deformity recorded as "probably spinal trouble." Later this seemed to be complicated by other nervous disturbances so serious that he was disposed of. The mother of 274.6 was 2A (297.1), which was normal, and concerning the ancestry of which there is uncertainty, as has been stated.

Discussion

Summarizing *Waltzer's* pedigree, then, we find first the possibly significant fact that his paternal grandsire and great grandsire were poisoned by drugs reputed to have a deleterious effect on the germ plasm, and

CHART I. *Pedigree of "Waltzer"*

- ♂ **301.3** "Waltzer"
  - ♂ 299.3
    - ♂ 20.2 (leaded)
      - ♂ 14.1—original purebred Dutch (alcoholized)
      - ♀ 15.1—original purebred Dutch
    - ♀ 1A (298.1)—Probably descended from 14.1
  - ♂ 274.6
    - ♂ **3A (296.1)**—Showed deformity, "probably spinal trouble," when about half grown. Later seemed to suffer other nervous complications and was killed. Probably descended from 14.1
    - ♀ 2A (297.1)—Probably descended from 14.1

CHART II. *Pedigree of Litter* 328

- ♀ 328.1
- ♂ **328.2**—paralyzed; killed when about 7 months' old
- ♀ 328.3
- ♀ 328.4
- ♂ 328.5
- ♂ 328.6
  - ♂ **301.3** "Waltzer"
    - ♂ 299.3
      - ♂ 20.2
      - ♀ 1A (298.1)
    - ♀ 274.6
      - ♂ **3A (296.1)**
      - ♀ 2A (297.1)
  - ♀ 293.3
    - ♂ **3A (296.1)**
    - ♀ 299.1
      - ♂ 20.2
      - ♀ 1A (298.1)

[4] COLE, L. J., and L. J. BACHHUBER. "The effect of lead on the germ cells of the male rabbit and fowl as indicated by their progeny." *Proc. Exper. Biol. and Med.,* Vol. XII, pp. 24-29. 1914.

second, that if the other grandparents are related as believed, there has been a considerable amount of inbreeding. The only record of any nervous defect in his pedigree is that of his maternal grandfather as noted.

A search of the records for other cases of possible nervous abnormality has revealed three such, and it would seem more than coincidence that they should all show relationship to the pedigree already given. This fact is emphasized when it is recalled that the records include hundreds of animals, many of which are related in one way or another to the descendents of 14.1 and 15.1, but many others which are in no way related to them.

An albino, own son (♂ 327.4) of *Waltzer*, produced by breeding him to his full sister (♀ 307.7) from a subsequent litter, exhibited a behavior somewhat similar to that of his father, but in a much less degree. This male was one of a litter of five born February 9, 1917, and the records contain the following note made February 26, 1918, when he was a year old. "When excited this animal shows a tendency to waltz similar to that of its father ♂ 301.3, though never makes but a turn and a half at one time. He makes a noise like that of 301.3." This male had two litters of young by related females and one by a female apparently unrelated, but no defects are recorded among the offspring.

Another of the individuals referred to was also a son of *Waltzer*, as shown in Chart II. This was a male in a litter (328) of six young, consisting of three males and three females, and was recorded as killed when about seven months of age because paralyzed. He is the only one in the litter mentioned as being in any way abnormal. The inbreeding in this case is again very pronounced; *Waltzer* was mated to his cousin, mate of *Waltzer's* father, and whose father was also *Waltzer's* maternal grandfather.

The third individual, which was likewise killed at about seven months of age because paralyzed in the hind parts, is shown in Chart III. Here again the same blood is found, the affected individual (♂ 374.7) being a grandson of 3A (296.1).

If we were to speculate on the basis of the charts here presented we might be tempted to conclude that the evidence points to the production of a germinal nervous defect of at least some general sort as a result of the treatment of males 14.1 and 20.2, either one or both. Further, that this inducted trait tends to be recessive, and as such traits do, to reappear as a result of inbreeding. And finally, we might go so far even as to suggest that since the nervous defect has shown itself only in males (the affected individuals are indicated in the charts by black face type), it is the sex chromosome which has been affected and the character is of the nature of a sex-linked recessive.

There are other facts, however, which would make such conclusions from the present data hazardous, to say the least. For one thing, it is by no means certain that the circus movements of *Waltzer* and his son 327.4, and the various degrees of paralysis of the others are to be referred to the same germinal cause, nor indeed, for that matter that they are necessarily germinal in origin. In the second place, the number of individuals which showed any sort of

CHART III. *Pedigree of Paralyzed Rabbit* 374.7

♂ 374.7—killed at about 7 months of age because paralyzed in hind parts

- ♂ 274.3
  - **♂ 3A (296.1)**
  - ♀ 2A (297.1)
- ♀ 2A (297.1)

unusual nervous disturbance was far too small for any simple Mendelian explanation, certainly; for, although *Waltzer* was bred to as many related females as possible, and the progeny were mated back to him and together among themselves, only one other individual with anything of his characteristic behavior was obtained. The records do not show at what age *Waltzer* began his dancing, but the cases of paralysis apparently did not come on until the rabbits were several months old. Since many of the youngsters died or were disposed of at an early age this might result in a considerable number of potentially defective individuals never reaching record. Finally the supposition that such disturbances as were found are to be attributed to the treatment of 14.1 and 20.2 is at most presumption, for it is possible that there was a latent nervous defect in the original stock when obtained.

All in all, however, we are inclined to feel there is a fair presumption that the behavior of *Waltzer* and the other affections may be attributed at least indirectly to either the lead or the alcohol treatment, and that they were probably the result of some germinal effect, but one of a rather general nature, not specific, at least in its manifestation. At any rate, the data seem to establish that while the waltzing of this rabbit resembled closely that of the mouse and rat, it certainly does not seem to be the same in inheritance. To what extent the circus movements induced in rats by rotation resemble in inheritance those found in nature we do not know, but the findings of Griffith, as presented by Detlefsen,[5] show a high incidence of circus movements among the descendants of rats which have been rotated.

Waltzer lived to the ripe old age (for a rabbit) of five years and ten months. In the latter part of his life he became less active and did not "dance" so frequently. In the last three months he was seen to whirl in his characteristic manner only once, and this was when he had fallen a distance of nearly five feet from his cage to the floor, which apparently excited him to the point of losing nervous control—if that is what his whirling signified. The poor fellow finally had an infection causing a swelling of his head and neck and involving his eye, and it seemed an act of mercy to put him out of his misery. At most, he probably could not have lived more than a few days, or possibly weeks, longer.

[5] At Toronto meeting of the American Society of Naturalists, December 29, 1921.

INTELLIGENCE AND RACE

A REVIEW OF SOME OF THE RESULTS OF THE ARMY INTELLIGENCE TESTS.—II. THE NEGRO

PAUL POPENOE
Coachella, California

IN tabulating the results of army tests of intelligence, the psychologists of the Surgeon General's office took a sample of 18,891 negroes for the purposes of analysis.[1] This gives a more nearly accurate picture of the negro population of the United States than any study hitherto made. While the inferences drawn from an examination of these records bring to light nothing previously unknown, they are of extraordinary value for the confirmation they give to conclusions earlier reached by many investigators, from other lines of evidence, regarding the mental status of the so-called colored population of the United States.

For the most part, the army statistics do not differentiate between full-blood negroes and mulattoes, and unquestionably a large part of the so-called negroes of the draft have white blood, often to a preponderant extent. The results must be interpreted with this fact in mind, for it is established that the intelligence of a "colored man" depends to a marked degree on the amount of white blood he has.[2] This conclusion, reached by several previous investigators, and supported by the verdict of "common sense" observation, is confirmed by several studies of the army psychologists.

At Camp Lee, for instance, "the experiment was tried of separating some of the negro recruits on the basis of skin color and comparing the intelligence ratings obtained from the lighter and darker groups. The report describes the experiment as tried on two battalions of negro recruits as follows: 'The lighter class contained those whose color indicated that they were true mulattoes or persons with a larger proportion of white blood than true mulattoes. The darker class contained pure negroes and those whose skin color indicated that they had a smaller proportion of white blood than true mulattoes. The classification was made by the various examiners of the groups.

"'In alpha [one of the standard army tests] the lighter negroes obtained a median score of 50; the darker a median score of 30. In beta [another standard test, devised particularly for illiterates and persons unable to speak English] the lighter negroes obtained a median score of 36; the darker obtained a median of 29.'"

In the data which I am about to present, therefore, it must be borne in mind that the showing of the negroes is improved by the presence of much white blood in many of them; and that to get at the real ability of the black man one would have to subtract no small amount from all of the scores to be mentioned.

Geographical Distribution of Intelligence

This fact undoubtedly has a bearing on the significant revelation of the tests, that the negroes in the Northern States are, on the average,

[1] *Memoirs Nat. Acad. Sci.* XV (1921) pt. III, Ch. 8.

[2] Apparently the same holds good for American Indians with various amounts of white blood. See the studies reported by Professor Hunter and Mr. Garth at the 1920 meeting of the *American Psychological Association*, in Chicago.

more intelligent than those of the Southern States. The cleavage is so marked as to lead one of the examiners (at Camp Dix) who made a study of 3,127 negroes of the July draft, to comment that "in general the Southern negro is as much inferior to the Northern negro as the negroes are inferior to the whites."

The negroes of Ohio made the best showing; those of South Carolina the worst. The great differences may be indicated by the fact that of two groups selected for study, the Northern negroes had 3.4% of A and B grades, with 45.6% of of D and D-, while the Southern negroes (from Alabama, Georgia, Louisiana and Mississippi) had but .03% in the A or B classes, and 86.2% in D or below.

How is this difference to be explained? It was found that the Northern negroes had less illiteracy, and conversely more education than those in the Southern groups. But since education is productive of results only to the extent that it has material to work on, one need feel no hesitation in concluding that the Northern negroes are inherently superior to the Southern; and two principal reasons suggest themselves. In the first place, it is possible that the Northern contingent represents a larger infusion of white blood than those who remain in the South; in the second place it seems certain that the more energetic, successful, and able of the Southern negroes are those who have had the ability and courage to break away from their home environments and come North; hence a selective influence has been at work to differentiate the two groups. But, to judge from all the studies available, the greater energy and ability of this group must be closely correlated with greater amounts of white ancestry.

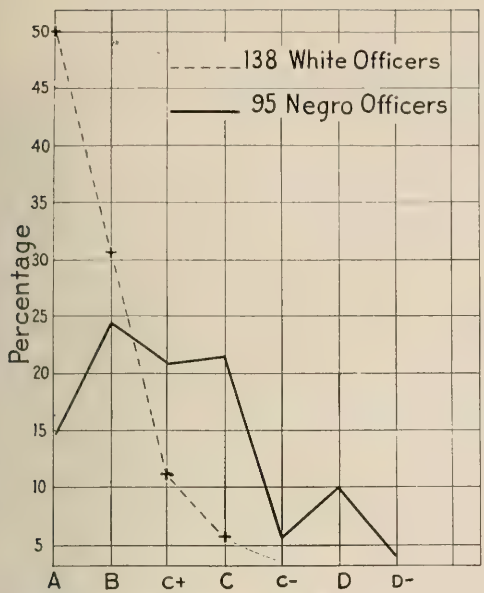
Just how great the difference between pure white and pure negro is, must, so far as these figures are concerned, be decided largely by inference, for the reason above noted, that most of the records, even of Southern negroes, apply to members of the race, many of whom have more or less white blood, and are therefore more favorable to the negro stock than actual facts warrant. It would be interesting to know whether the negro officers were, on the average, noticeably lighter in color than the negro in the ranks. It seems probable that they were, since their superiority to their fellows is marked; indeed, the negro officers, who represented a highly selected lot, represent almost the same distribution of intelligence as the average of the entire white draft. When the negro officers are compared with a white group equally selected—namely, the white officers—the true comparison is made and graphically shown in figure 1.

While the evidence seems to warrant the conclusion that qualitative differences between the negro and white minds do exist, the greatest difference is unquestionably merely one of degree. The average mental age of the white draft army was 13.08 years; the average of the negro was that of a normal white child of 10.37 years.[3] For adults this degree of intelligence would place a white man definitely on the "border-line" of feeble mindedness.

Naturally, the army examiners were concerned mainly with the negro's fitness for military service. But, as the report observes, with the white men the tests were used to detect and eliminate those not good enough for service; while with the negroes they served more to detect the few who were good enough for service.

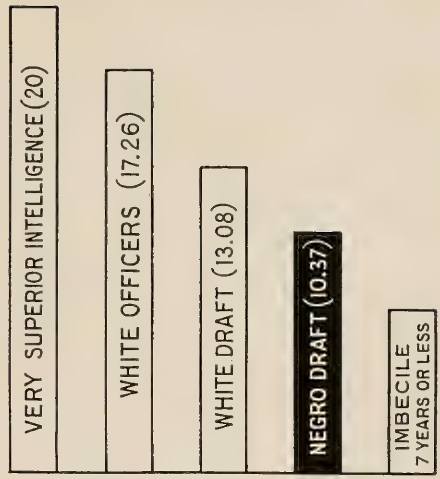
More specific information was sought at Camp Upton, where the company commanders were requested by the chief psychological examiner to make out, with the assistance of their lieutenants and first sergeants, a list of 50 negro recruits, 10 of whom, in their estimation, fell in each

[3]The curve for negro literates is close to that for white illiterates.



NEGRO AND WHITE ARMY OFFICERS

FIGURE 1. These curves, representing mental tests of negro and white American army officers, show clearly the differences in their intelligence. Both groups were highly selected, but the negro group probably represents a more stringent selection from the whole negro population, than the white group does from the white population. The negroes are not only inferior in average intelligence, but they show a small proportion of very superior men, as compared with the whites.



THE RANGE OF INTELLIGENCE

FIGURE 2. In the graph above, the length of the columns represents the mental age of the groups named, on the conventional scale, now widely used, in which 20 years is taken as indicating very superior adult intelligence, and 16 years as the intelligence of the normal adult. An adult who has the mentality of the normal 7-year-old white child would generally be regarded as an imbecile, or very low grade feeble-minded. The negro drafted men, on the average, are about half-way between this point and the general level of the white draft, which in itself was nearly three years below the level that has hitherto been taken as the standard of normal adult intelligence.

one of the following five designated classes:

A. Very superior. Equal to good white sergeant or white officer material.

B. Superior. Level of good white non-commissioned officers.

C. Level of good white privates; the large average group of the white draft.

D. Inferior. Only just good enough to make a satisfactory soldier.

E. Very inferior. Too poor to make a satisfactory soldier.

The results of the investigation are summarized as follows:

"(a) Less than 2% of negroes are of A value to military service when compared with white troops.

"(b) About 25% are considered by their officers as 'too poor to make a satisfactory soldier.' Most of them are D intelligent or less.

"(c) Nearly all the negroes who rate D- or E in intelligence and about half of those who rate D in intelligence are 'too poor to make a satisfactory soldier.'

"(d) D- intelligence is seldom more than just barely satisfactory."

The correlation between estimated military value and intelligence rating, as measured by the tests, was worked out and found to be .6.

These estimates are open to the charge that they were made by white officers, and therefore subject to the bias of race prejudice. Written comment of the officers was invited and is summarized as follows:

"(a) All officers without exception agree that the negro lacks initiative, displays little or no leadership, and cannot accept responsibility. Some point out that these defects are greater in the Southern negro.

"(b) All officers seem further to agree that the negro is a cheerful, willing soldier, naturally subservient. These qualities make for immediate obedience, although not necessarily for good discipline, since petty thieving and venereal disease are commoner than with white troops."

These conclusions as to the negro's relative inferiority for responsible military service are apparently borne out by the service records of the negro regiments sent to France.

As the conclusions of the army tests agree with those made under other auspices, it may be taken as certain that the negro is, as measured by intelligence tests, markedly inferior to the white men among whom he lives. Is this inferiority an innate and ineradicable condition, or is it, as some have supposed, merely a handicap due to unfavorable tradition and environment?

Professor Johnson and I have elsewhere pointed out the historical indications that the negro's low mental estate is irremediable.[4] If the number of original contributions which his race has made to the world's civilization is any fair criterion of its relative value, then the negro must be placed near zero on the scale.

"The following historical considerations suggest that in comparison with some other races the negro race is germinally lacking in the higher developments of intelligence.

"1. That the negro race in Africa has never, by its own initiative, risen much above barbarism, although it has been exposed to a considerable range of environments and has had abundant time to bring to expression any inherited traits it may possess.

"2. That when transplanted to a new environment—say Haiti—and left to its own resources,[5] the negro race has shown the same inability to rise; it has there, indeed, lost most of what it had acquired from the superior civilization of the French.

"3. That when placed side by side with the white race, the negro race again fails to come up to the higher standard, or indeed, to come anywhere near it. It is often alleged that this third test is an unfair one; that the social heritage of slavery must be eliminated before the negro can be expected to show his worth. But contrast his career in and after slavery with that of the Mamelukes of Egypt, who were slaves, but slaves of good stock. They quickly rose to be the real rulers of the country. Again, compare the record of the Greek slaves in the Roman republic and empire, or that of the Jews under Islam. Without pushing these analogies too far, is not one forced to conclude that the negro lacks, in his germ-plasm, some qualities which the white races possess, and which are essential for competition with the civilizations of the white races of the present day?"

The mental tests strongly support this conclusion; for they measure traits which are largely independent of schooling. They point clearly to the fact that the observed inferiority of the negro is to a large extent one which no amount of education, or favorable environment can obviate. While there are many bright negroes, and many dull whites, the average of the two races is measurably different. The negro is mentally, therefore eugenically, inferior to the white race.

All treatment of the negro, in the United States or elsewhere, must take into account this fundamental fact.

[4] *Applied Eugenics*, by Paul Popenoe and Roswell Hill Johnson, New York, 1918, p. 284.

[5] "The most satisfactory settlement of this discussion may be found, I believe, in a careful study of the negroes of Liberia, a state founded with free negroes, a state in which the negroes have been allowed full and free expression of their inheritance, in a natural climate, where advice of the whites has been available, but their blood has been withheld. Surely here, if anywhere, at the present time one should be able to observe the negro's possibilities, unhampered by slavery or race oppression."—Harris, Reginald G. "Eugenics in South America." *Eugenical News*, vii, p. 28, March, 1922.

A BLACK LEGHORN WHICH TURNED WHITE

F. A. E. Crew

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On June 24th, 1921, a Black Leghorn hen was sent to this Department by Mr. A. Backhouse, of Pontefract, in response to an appeal for "hens which had assumed the characters of the male." She was then eighteen months old, belonged to a heavy laying strain and had herself a very satisfactory egg-yield. During the three months previous to her arrival here, her comb had become progressively larger and more and more erect. She began to crow, not lustily, nor with a challenging note, but like a youngster practising. Her plumage was entirely black and hen-like, her spurs mere buttons (5½ mm.); her sexual behavior was that of indifference: she did not behave as a cock towards hens, nor as a hen towards a male. The most remarkable features were her large erect comb, measuring 11.6 cms. x 8 cms., and her weak effortful crowing, to perform which it was necessary for her to fly on to some high place. She did not perform any of the wing-flapping actions of the male when about to crow.

As she was allowed the freedom of the yard, her wing primaries were cut. During August she began to moult and the neck hackle, those primaries which were missing when the wings were clipped, and some of the fluff were replaced by feathers which were mainly white but had irregular "washed-out" black centres. The vascular tissue of the head furnishings became more and more congested. During the next year she moulted steadily and each feather as it was lost was replaced by a still whiter one, until at the time of her death in October, 1922, she was a white bird with a few irregular splashes of vestigial black. It was noted that the primaries which were clipped were not moulted until a year had passed. A few of the neck-hackle and saddle-hackle feathers were definitely cock-like in appearance and structure. During the later months of her life she became progressively more quiet, ceasing to crow and seeking solitude.

Postmortem examination showed that she had died from internal haemorrhage. Occupying the situation of the ovary was a large tumor the surface of which was invested by a mesh of dilated tortuous veins, one of which had ruptured. The tumor, weighing 103.4 grammes, measured 7.5 x 6.3 cms. and was blood colored. On one surface an area of what seemed to be ovarian tissue was found, the rest of the tumor had the form of a solid fleshy mass. The oviduct was as small as that of a resting bird.

On section, the ovarian portion of the tumor proved to be completely atrophic, no trace of germinal tissue could be found and only in one section could follicular remains be identified; these consisted of a mass of vacuolated cells encapsuled by connective tissue and attached to the rest of the ovary by a fibrous cord containing groups of luteal cells, and probably representing an old discharged follicle. With this exception the ovarian part of the tumor consisted entirely of connective tissue stroma, the peripheral parts of which were mainly cellular, whilst the inner (sex cord) region consisted almost wholly of white fibrous tissue. The interstices and folds of the ovary were packed with erythrocytes derived from the haemorrhage which caused the death of the bird. Luteal tissue was present in the form

January 24, 1921

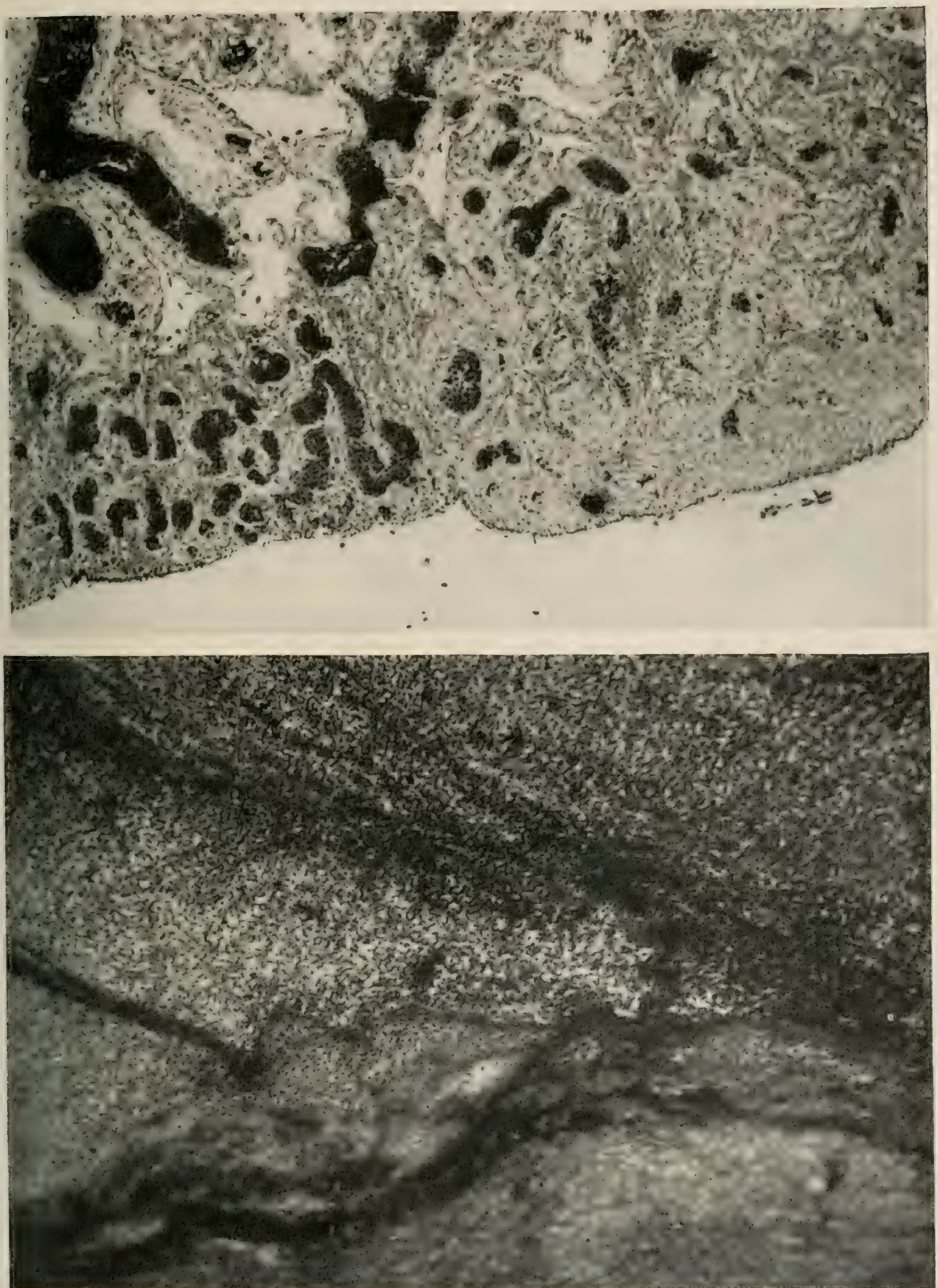
September 15, 1921

April 12, 1922

October 22, 1922

CHANGING FROM BLACK TO WHITE

FIGURE 3. The first unusual thing noticed about this hen was that she began to take on cock-like characteristics. The large comb is the most noticeable of them. She also began to crow. Then, every time she moulted some of her black feathers were replaced by lighter colored ones, and in less than twenty-one months she had become almost entirely white. Her adrenal glands were found to be atrophied, and it is possible that the changes in metabolism brought about by a lack of their secretions resulted in this change of color. In humans the rare and fatal "Addison's disease" is always accompanied by a diseased condition of the adrenals, and by a peculiar pigmentation of the skin.



TWO SECTIONS THROUGH THE TUMOR

FIGURE 4. Above is a section through the ovarian part of the tumor, showing the entire absence of any follicular tissue. Below is a section through the blood clot. Nothing resembling normal ovarian cell structure is present. Apparently it was this degeneration of her ovary that caused the hen to take on cock-like characteristics.

OVARY AND ADRENAL OF TWO-MONTHS-OLD CHICK

FIGURE 5. Showing the cellular continuity of the ovary and adrenal. In the hen they are histologically continuous, at least up to the time of laying. Consequently it is not remarkable that tumor growth affecting the ovary should involve the adrenal also.

of groups of cells most numerous in the proximal portion, but scattered throughout the gonad. In the region immediately adjacent to the non-ovarian part of the tumor these cells were extremely numerous and on section appeared as a continuous band. The luteal cells were everywhere most conspicuous, being without exception crowded with pigment granules which frequently obscured all cell structure. The rest of the tumor was composed entirely of laminated blood clot, fibrin and nucleated red corpuscles with no evidence of any structural tissue elements. The red blood corpuscles had undergone lysis.

Origin of Luteal Cells

The condition of the luteal cells is of interest in view of Morgan's hypothesis that it is this element of the ovary which is responsible for the henny feathering in birds. The histology of the luteal tissue has been studied by Pearl and Boring, and according to these authors it is first seen as islets of clear cells situated in the walls of the follicles and in the general stroma. In atretic and discharged follicles these multiply and the cells migrate into the cavity where they develop granules of lutear pigment in the cyptoplasm. This account of the transition of the islets of clear cells into luteal tissue is not wholly convincing and on theoretical grounds would appear unlikely. The histogenisis of these islets of cells is being studied by Miss H. B. Fell, in this Department, and she finds that they arise in the distal portion of the sex cords, confirming the conclusions of Fikert and Nonicles. Owing to the enlargement of the oocytes and relatively slight increase in the stroma they finally come to lie among the former and are mostly incorporated in the follicles. It would seem more prob-

A MASS OF LUTEAR GRANULES

FIGURE 6. The exact function of the corpus luteum in birds is obscure. Some investigators believe it is responsible for the development of typically female plumage. However, this view would receive small support from the conditions found in this case, as the great amount of lutein present has not inhibited the development of male plumage and of other male characters.

able that the pigment-bearing cells of the fowl are formed, as in the Mammals, from the theca interna and are quite distinct from the islets. This conception requires that the secondary sexual characters might be controlled: (a) by the islets, or (b) by the pigment forming tissue. But as the latter tissue is not present in the young pullet, it would seem that the former are responsible for the development of the female type of plumage. Whichever view is taken, however, the histological study and the history of the fowl described in this paper point to the conclusion that ultimately, had she lived, she would have assumed male plumage.

From the examination of many other cases (as yet unpublished) of atrophic ovary in the hen, the conclusion has been arrived at that the formation of large quantities of pigment in the luteal cells is a sign of degeneration, the final stage of which is a structureless mass of lutear pigment lying among the stroma. If this is so, the cells in this case must have been almost functionless. On the other hand, if the small groups of clear cells are not homologous with the lutein-forming cells and are responsible for henny-feathering, then this fowl would undoubtedly have assumed the male type of plumage earlier since in this case these islets are entirely absent.

The tumor was firmly adherent to the dorsal body wall. After it had been carefully removed the adrenals were sought for. Neither could be found and from the relations of the tumor it was thought that these glands had become incorporated in the tumor. Nothing suggesting adrenal tissue, however, was identified on section of the tumor. It was hoped that it could be demonstrated that abnormality of the adrenal was associated in this case with the peculiar change in the pigmentation of the plumage. It is known that abnormality of the adrenal in the human is often associated with abnormality in pigmentation, as in Addison's disease. Save that neither adrenal could be found, even after the most careful search, nothing more can be said. It is possible that the progressive destruction of the adrenal was indeed responsible for the gradual change from black to white and that the complete destruction of these glands resulted in the death of the bird.

Continuity of Adrenal and Ovary

It has long been known that there is an intimate relation between the cortex of the adrenal and the gonad in the earlier stages of development. Microscopic examination, however, has shown that the ovarian and cortical tissues in the fowl are closely adherent and in fact are histologically continuous locally not only in the embryo but at least up to the time of laying. No previous reference to this point has been encountered and so this opportunity is taken to place the observation on record. Under these circumstances it is not remarkable that tumor-growth of the ovary should involve the adrenal.

SCIENCE IN THE SCHOOL

A Review

THE TEACHING OF GENERAL SCIENCE by W. L. EIKENBERRY, Associate Professor of General Science, University of Kansas. The University of Chicago Press, xiii+169 pp. 1922. Price $2.00 net.

As new subjects, particularly new sciences, develop there is a tendency to incorporate them in some form in secondary school curricula, either on the plea that since many of the students go no further this will be their only chance for an acquaintance with these subjects, or on the theory that being introductory these courses will stimulate a desire for further knowledge in the same fields. Courses in special sciences have however, been severely criticized on one ground or another, and in recent years there has been a tendency to bring in courses of a more general nature. Thus a few years ago Nature Study, so-called, was all the vogue, and more recently this has been evolved into what is currently called General Science. Professor Eikenberry's book is a critical consideration of science teaching and its objectives and an exposition of the methods of general science. General Science, as he visions it, has a difficult road to follow, being liable on the one hand to become merely an elementary treatment of one or two general sciences and on the other of being simply a smattering of a lot of things from several sciences, without a definite goal and carrying the danger of dulling the student's desire for pursuing the subjects further. The solution is believed to lie in the organization of the General Science course around things which pertain to the student's everyday life and interests. "General Science is built up largely with materials which have interest because of utilitarian and socializing values." It seeks to supply a common foundation. "It assumes that it is not possible to rise into the higher intellectual levels during the first year, and it therefore contents itself with attempting to organize the immediate and familiar environment of the pupil in as useful fashion as possible. It may go farther and indicate in which directions the principal fields of science lie, but it leaves for later science study the more philosophical organization of those fields."

While heredity and eugenics are not specifically discussed as material for a course in general science, it would seem that they both, and particularly certain phases of eugenics, offer subject matter of intimate and vital interest to the pupil and with distinctive social-civic value. On the other hand, an attempt to teach to high school students the complicated principles and relationships of Mendelism would, in the opinion of the reviewer, be a great mistake, and this view would seem to be shared by the author (p. 61.).

One is inclined to conclude that in its present development at any rate, perhaps even more than in one of the old well-established special sciences, the real value and success of a course in General Science will depend on the broad training, sympathy and ability of the teacher.

L. J. C.

AN ORCHARD OF CHESTNUT HYBRIDS[1]

J. A. Detlefsen and W. A. Ruth
College of Agriculture, University of Illinois, Urbana, Illinois

A HYBRID BETWEEN JAPANESE AND AMERICAN CHESTNUTS

Figure 7. In 1898 Mr. Endicott was successful in obtaining five chestnuts by crossing the Japanese and American species. From these he raised three trees, of which this is the largest. The trees were remarkably vigorous and fruited precociously, one at seventeen months, one at four years, and the other at five years of age. The Japanese chestnut does not usually begin to bear until it is six years old, the American at about twelve years. See text, p. 306.

WITH the rapid disappearance from the American continent of the native chestnut tree through the ravages of the chestnut bark disease, there has come the demand for a substitute. The discovery in China of a species of chestnut resistant to this disease, and the ease with which hybrids between the different species can be produced has led to the hope that hybrid chestnut trees may take the place of the native American species. Mr. J. F. Rock, the agricultural explorer, is now in China collecting all the species of chestnuts he can find there in order that this breeding material may be placed in the hands of American plantsmen, to be used for crossing with the native species to develop the new hybrid chestnut. This article, which calls attention to what a single plant breeder was able to do with the material at his disposal, has a direct bearing on this important problem.

In many parts of the Appalachian Mountains the chestnut is, or was, the most abundant and important forest tree. In some places it made up fifty per cent of the hardwood timber; and it has been estimated to have constituted at least ten per cent of all the hardwood forests in the eastern United States, before the ravages of the bark disease began. Unless it is possible to develop a resistant hybrid that can be easily propagated, one of our most beautiful and useful trees is doomed to disappear from American forests.

Editor.

[1] Paper No. 19 from the Genetics Laboratory, College of Agriculture, University of Illinois. The writers are indebted to Professor J. C. Blair, who furnished some of the facts relating to the early history of this orchard and also made possible an opportunity to visit it.

OCCASIONALLY on some remote farm or ranch a genuine Mendelian experiment of great interest and significance is performed and lies entirely buried until a fortunate accident brings it to light. Our former Colleague, Professor E. W. Bailey, kindly drew our attention to such a case—an orchard of unique chestnut species hybrids. He later placed at our disposal some of the materials which he had collected. We are presenting some of the more obvious and striking facts for the sake of their scientific, historic and practical value. The case is especially valuable, since it affords an excellent example of genetic laws in tree hybridization. In 1899 Mr. George W. Endicott, of Villa Ridge, Illinois, crossed the Japanese chestnut, *Castanea japonica* (probably variety Coe, but known locally as Japan Giant) with pollen from the American sweet (*C. americana*). The mere cross in itself was hardly remarkable, inasmuch as several chestnut species crosses had been made before. But Mr. Endicott raised an orchard of about 175 second generation hybrids which are particularly interesting to the geneticist, since all of these trees are now twelve to fifteen years old and are bearing.

Introduction of European and Japanese Species

Edible chestnuts are sometimes divided into three large groups (or species), the American, European, and the Japanese. All three are now grown in this country, but only the first is indigenous. The history of the earliest introduction of the European species is rather obscure, but the general dissemination of this chestnut certainly dates back to about 1800,[2] when Eleuthere Irenee du Pont de Nemours planted a number of French chestnuts in his garden near Wilmington, Deleware, where he had settled after emigrating with his family to America in 1799. The descendants of these trees or their scions have been extensively propagated in this general region of the United States. However, there must have been isolated cases of importation before this time, because there is an obscure record[3] that Thomas Jefferson grafted the French marron to the American sweet in 1773, at his home in Monticello, Virginia. The importation of the Japanese species was much more recent and was the direct result of attempts to introduce this type on a commercial basis. The S. B. Parsons Co. of Flushing, N. Y., in 1876; William Parry, of Parry, N. J., in 1882; and Luther Burbank, of Santa Rosa, Cal., in 1886, were among the earliest nurserymen and horticulturists to attempt this importation and introduction. The last of these importers planted over 10,000 Japanese seedlings and selected three as desirable—the Coe, the Hale, and the McFarland. Mr. Burbank had several hundred hybrid chestnuts just beginning to bear about 1899—from crosses involving the chinquapin, the Japanese, European, and Chinese chestnuts, and other types, according to Powell's[2] report. Van Fleet[4] produced hybrids involving European, Asiatic and American types between 1894 and 1911. We have, however, little or no information on the segregation in the second hybrid generation in either of these cases. Mr. Endicott made his first successful cross about this time, i. e., in 1899.

Mr. Endicott's Crosses

Mr. Endicott was much interested in hybridization and recognized its possibilties for the chestnut, since he had perfected the Endicott plum and other fruits. Practically throughout his whole life he was interested in

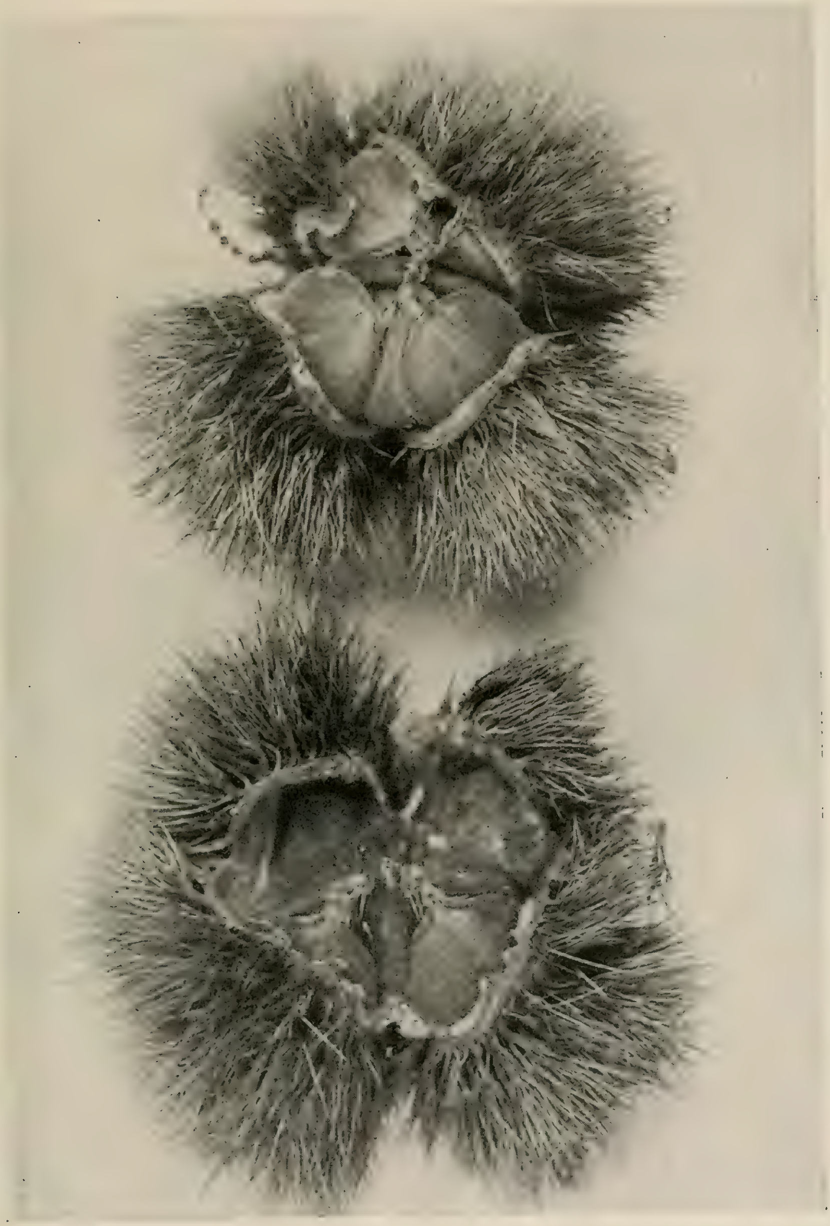
[2] Powell, G. H. *11th Annual Report*, Delaware Agricultural Experiment Station. 1900.
[3] Bailey, L. H. *Standard Cyclopedia of Horticulture*, MacMillan Co., N. Y. Vol. II, p. 742. 1914.
[4] Van Fleet, W. *Journal of Heredity*, Vol. V, No. 1, pp. 19-24. 1914.

LARGEST AND SMALLEST TREES OF THE SECOND GENERATION

FIGURE 8. The results of Mr. Endicott's first crosses were so encouraging that he raised a second generation from the Boone, which he considered the most promising of his three original hybrid trees. As a means of increasing his stock of superior trees this effort was a failure, for the greatest variation was found in the second generation trees. Some were vigorous growers while others were of dwarf habit. Soil conditions may have been a factor in producing the contrast in size shown above, but it is certain that the hereditary constitution of the two trees had something to do with it, as the smaller one is perfectly healthy and bears heavily.

NUTS FROM TWO OF THE SECOND GENERATION TREES

FIGURE 9. All nuts from the same tree are remarkably similar, but those from different trees vary greatly in size and shape and in the amount of tomentum. Some trees have several nuts to the burr, others only one. In some cases the nuts are free in the burr, like the Japanese, while other trees have nuts as firmly attached to the burr as the American sweet.

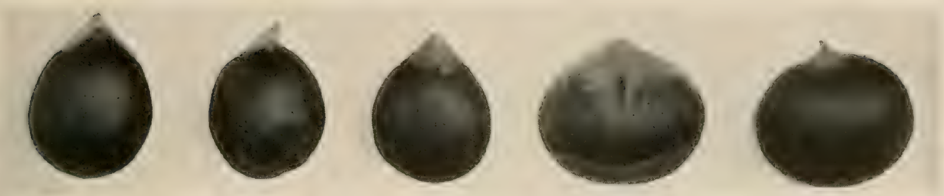


MANY NUTS TO THE BURR

FIGURE 10. Some of the segregates gave as many as seven or eight nuts to the burr, whereas the Japanese parent has one and the American parent three. The nuts from such burrs are too small and misshapen to be of any great value.

THREE GENERATIONS OF CHESTNUTS

FIGURE 11. The topmost row consists of two Japanese chestnuts on the left and three American sweet on the right. The next two rows are nuts from the three first generation hybrid trees, the group of four nuts on the left being from the Blair tree, the center four from the Boone, and the four on the right from the Riehl. Note the similarity in size, shape and the amount of tomentum. The last three rows are made up of selections from the 175 trees raised from the Boone tree, and show the extreme variation encountered in the second hybrid generation. See text, p. 313.



NUTS FROM THE SECOND GENERATION TREES

FIGURE 12. These nuts show further variations in the second generation. The three on the left are acorn-shaped, being from trees that produced but a single nut in a burr. The two on the right are nearly the same size, but they are flat on one side and the amount of tomentum is very much less on one than on the other. See text, p. 314.

plant improvement. Born in 1839, he was 60 years old when he made his first successful chestnut species cross. He was 70 years old when he planted a large orchard of over 150 F_2 trees. He died in 1914 without seeing the final results of the second generation of his interesting cross. In choosing the Japanese and the American sweet for hybridization, Mr. Endicott probably had in mind the combination of certain very desirable characters from each parent. He had a large number of American sweet chestnuts growing on his land, but he wished to improve them, for he recognized their shortcomings as well as their desirable qualities. The Japanese type has the advantages of a large nut lying free in a relatively smaller burr, is rather resistant to weevils, blooms and matures early, and has a nut with more attractive color and less tomentum; while the American type has three small nuts very tight in the burr, is susceptible to weevils, blooms and matures later, and has nuts of poor color and heavy tomentum. The American sweet, however, has nuts of fine quality with a thin skin, grows vigorously and produces a large tree, whereas the Japanese has poorer quality (at least in many cases), a thick skin, and produces a low bushy tree of delicate growth. A combination of the desirable features from these two sources naturally recommended itself to Mr. Endicott and therefore he attempted to make the cross.

He seemed to have some difficulty in the routine technique, for the Japanese and the American sweet differed in time of blooming. Eventually he produced five hybrid seeds from which he raised three trees, naming them the Blair, the Boone, and the Riehl. As we might expect, the three trees of the first generation were not all exactly alike, for the parents (at least the Japanese) were more or less heterozygous. As a matter of fact, it is surprising that the three trees were as nearly similar as we found them. Like the American sweet, the Blair and Boone produced three nuts to the burr, while the Riehl produced a single perfect nut with an aborted nut on each side like the Japanese parent. All three first generation hybrids produced nuts free in the burr like the Japanese parent. All of these trees showed tremendous vigor (Fig. 7.) The largest, the Riehl, had a spread of forty-five feet when twenty years old. The Blair and Riehl began to bear at four and five years, respectively, while the Boone bore its first nuts at seventeen months. When we compare this with the Japanese and the American parents, which begin to bear at about six and twelve years, respectively, we gain some idea of the precocity which accompanied the hybrid condition. Van Fleet[4] reports similar vigor in crossing Asiatic and European chestnuts with the chinquapin and the American sweet—the Japanese hybrids being again the most precocious. These hybrids were likewise heavy bearers, the Boone producing as much as six bushels in

A PARENT TYPE AND TWO SECOND GENERATION SEGREGATES

Figure 13. The American sweet on the left is almost indistinguishable from the adjoining burr, which is a second generation segre-
gate. The burr on the right is also from a second generation tree, but it almost exactly resembles its Japanese ancestor. Only one
nut has developed and the two aborted side nuts, or "side blasts," offer no hindrance to the formation of a rounded, acorn-like nut.
It is interesting to note that one desirable quality has been passed on by the Japanese parent to nearly all of its offspring. This is
resistance to attacks by weevils, whose love for the American sweet has given rise to that ancient "chestnut," "what is worse than
finding a worm in a chestnut?" With one exception all of the trees of the Japanese-American cross are free from weevils. Year
after year, this tree, although surrounded by an orchard of trees untouched by weevils, is badly infested and harbors a large crop of
them. See text, p. 314.

a single season. The vigorous growth of the hybrids is shown by their having a spread of over forty-five feet, while the American sweet and the Japanese parents measured about thirty and sixteen feet, respectively.

The Second Generation

The first generation hybrids, particularly the Boone with its vigorous growth, early maturity, and with an abundance of nuts of excellent quality and large size aroused Mr. Endicott's interest to such an extent that he planted over 175 seedlings from this particular hybrid tree. A first planting of twenty-five second generation seedlings was made in 1906, and a second planting of over 150 was made in 1909. All of these are undoubtedly genuine second generation hybrids, because the three first generation trees were quite isolated in a field almost a mile from the nearest American sweet. While all the second generation hybrids were grown from the Boone nuts, it is of course possible that the male parent was occasionally either Blair or Riehl, since the three trees were planted in a row and spaced about one hundred yards apart. This does not vitiate our Mendelian experiment, for in any event the second generation trees came from the first generation mated interse, and probably all or nearly all of them actually came from the self-fertilized Boone hybrid.

In perpetuating the Boone chestnut, by growing a second generation, Mr. Endicott had hoped to see a fairly constant repetition of the excellent qualities of his first three hybrids, namely three large nuts of good color and quality with little tomentum, lying free in the burr, and a vigorous heavy yielding tree. Of course, he was doomed to disappointment in this respect, because the most pronounced segregation was inevitably predetermined. The second generation trees were very uneven in growth and size. The smallest was hardly more than eight feet high, while the largest was about twenty feet high, when they both were fourteen years old (Fig. 8). None of the trees showed the extreme vigor or precocity or heavy-bearing qualities characteristic of the first generation. While the original Boone tree bore its first nuts at seventeen months, the second generation Boone trees were from five to nine years old before bearing; this range almost covers the difference between the original Japanese and American sweet parents. The time of ripening also showed wide variation, since it overlapped both parents. In 1920, for example, the second generation trees ripened their nuts from the first week in September through the middle of October.

In size of nuts the trees showed unmistakable segregation. The nuts of the original hybrid were intermediate between both parents, but these trees gave a greatly increased range of sizes (Fig. 11). Some were as small as the American sweet, and all grades were found up to forms larger than the first generation Boone and almost as large as the Japanese. The amount of tomentum was intermediate in the first generation, and showed a great range in the second. Almost any size nut could be found with any degree of tomentum. The first two and last two F^2 nuts in Fig. 11 illustrate this point. While the nuts on different trees showed a great range of variation in size, form and tomentum, the nuts on any individual tree were remarkably uniform. Figure 9 shows two groups of these second generation nuts. Each group, coming from a single tree, is uniform within itself, but one group gives consistently larger nuts, with slightly more tomentum.

Most of the trees gave three nuts to a burr, but some gave only one nut with two aborted nuts like the Japanese parent (Fig. 13), and others gave as many as eight nuts in a burr (Fig. 10). When a tree produced singles these were often ovoid or acorn-shaped (Fig. 12). While all three of the original hybrid trees pro-

duced nuts free in the burr, segregates appeared in the second generation with nuts just as firm as those of the American sweet. Probably fifty per cent. of the trees produced free nuts, while six per cent. were very tight, the remainder being intermediate. Segregates closely resembling the American sweet were found, both in size, shape, number of nuts and character of burr (Fig. 13).

Resistance to Weevils

For many years all the trees of both generations with one exception have been resistant to weevils like the Japanese parent. The single exceptional tree has always given nuts badly infected with weevils, while all the rest of the trees in the orchard have been immune.

The character of the burr also showed much variability in the second generation in respect to thickness, length of spines and the like. The spines of some burrs were relatively soft and easily handled, while others were extremely rigid. All gradations between these extremes were found.

When it was found that the second hybrid generation was so exceedingly variable and not as valuable as the original hybrid, an attempt was made to propagate the parent vegetatively by grafts and by top working the worthless second generation seedlings with original Boone wood. Mr. Endicott was accomplished in the art, but never had much success in the use of F_1 wood on F_2 trees. In many trials (over 400) made by Mr. Endicott and Mr. E. A. Riehl (an expert nurseryman) about three per cent. of the attempts to bud or graft were successful. Possibly some obscure anatomical or physiological peculiarities of the wood of the first generation make a union with other woods difficult, even with its own seedlings.

All of these striking variations in the second generation trees bear the earmarks of multiple factor segregation and recombination. There are many other characters involved besides these more patent examples which we have chosen to record. No doubt intricate structural and physiological characters are also included. The orchard might prove to be a storehouse of promising material for anyone inclined to pursue investigations in this direction.

How Relatives Originate

THE EVOLUTION OF KINSHIP, AN AFRICAN STUDY, by E. SIDNEY HARTLAND, LL. DL., F. S. A. The Frazer Lecture, 1922. Pp. 31; price 70c. Oxford University Press, American Branch, New York, 1922.

Drawing his illustrations mainly from some of the Bantu tribes, which inhabit Africa from the equator to the south coast, Dr. Hartland sketches the primitive state in which descent is traced through the mother, followed by the slightly more advanced stage in which it is traced through the father. In both instances the relationships are thought of by the individuals concerned as social rather than physiological. The two systems of descent are in many tribes still competing for supremacy, which results in some involved situations that are interestingly set forth.

—*P. P.*

BEAVER FARMING

VERNON BAILEY

Biological Survey, U. S. Department of Agriculture

A CAPTIVE BEAVER

FIGURE 14. This old gentleman was caught in a pitfall for study. He was quite gentle and easy to handle from the first. Beaver farming is an industry still in the experimental stage, but offering great possibilities. Land not suited for any other purpose can be used, and deforested areas could be made to produce valuable crops of beaver fur while being reforested. Photograph from U. S. Biological Survey.

A NEW line of fur farming promises an important addition to our rapidly diminishing supply of the warmest clothing known. *Beaver Habits, Beaver Control, and Possibilities in Beaver Farming* is the title of a bulletin just published by the Department of Agriculture, in which it is shown that while the actual raising of beavers on a business basis is still in the experimental stage, enough has been done to show that there are no insurmountable obstacles to be overcome. Beavers are easily tamed, and become very gentle and affectionate pets; they breed in captivity, are contented as long as there is a satisfactory food supply, and are easily fenced and kept within bounds. Their favorite food consists of the bark of small aspens, cottonwoods, willows, pin cherries, and other bushes and trees of little or no value for timber purposes, and they thrive and produce the best fur in regions too cold and rough for successful agriculture.

Beavers begin to breed when only a year old, and when two years old are practically fully developed. Four is the usual number of young in a litter, but there are records of six and a few of eight. While reproduction is less rapid than in most rodents, the beavers have few enemies except man and are

A BEAVER LODGE

FIGURE 15. Beaver houses are made of mud and sticks and their construction represents no mean feat of strength and skill for the little animals. The branches of a winter food-cache of sunken wood are visible on the left, the buds and bark being the parts that are relished. Photograph from U. S. Biological Survey.

BEAVER WOODCRAFT

FIGURE 16. Yellow poplars cut by beavers for food and building material. Aspens, poplars, and cottonwoods are favorite food and easily cut. Canals are dug in which to float the trees to the pond. Photograph from U. S. Biological Survey.

BREAKFAST TIME

FIGURE 17. Baby beavers getting their meal from ordinary baby bottles, which they would call for vociferously every three hours. Four is the usual number of young born in a litter, but cases are on record of six or even eight being born at one time. Selection of more prolific strains would be one of the qualities the beaver farmer could work for. Photograph from U. S. Biological Survey.

WORK OF THE BEAVERS

FIGURE 18. This dam across a creek in the Adirondacks holds water about four feet above the original level. Beaver activities sometimes bring them into conflict with man, as their dams have caused flooding of fields and railroad tracks. Photograph from U. S. Biological Survey.

extremely healthy and hardy, so that actual increase under favorable circumstances is rapid.

The key to success in beaver culture, however, is going to be selection and improvement of breeding stock. The darkest and handsomest deep ebony-brown beaver fur is found along the south shore of Lake Superior, where skins are worth two or three times as much as those of the paler varieties from the Western and Southwestern States. Skins from this region have sold for as high as $50 in the open market, and choice, bred-up, and perfectly prime skins should be worth considerably more than trapper's prices. Very long and almost black beaver fur comes nearer in general appearance to sea otter fur, the most valuable fur in the world, than any other fur known. Moreover, if well kept and properly combed, it is very durable and warm, as well as beautiful.

Fortunately there is an ample supply of choice beavers obtainable, so that no one will be able to corner a market on the best breeding stock and run prices to an unreasonable figure. The industry of raising beaver fur should be well adapted to large, as well as small tracts of suitable country, and its greatest value promises to be in the development of immense areas of north country now considered almost worthless. Burnt-over and cut-over timber lands usually carry the best growth for beaver food, and while paying a profit in fur these areas can be slowly reforested with valuable timber.

THE USE AND VALUE OF BACK-CROSSES IN SMALL-GRAIN BREEDING

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BACK-CROSSES have long been used in animal breeding to fix desired characters in cattle, horses, or other live stock. Despite any bad effects of inbreeding, back-crossing has been one of the best methods of retaining desired variations of conformation or other intangible complex characters.

So far as the writers know, back-crosses have not been used in small grains to secure definite types in the progeny. They have been used to study inheritance and incidentally have entered into the complex hybrids made more frequently by early plant breeders than at present. They seem to have been largely if not entirely neglected in any definite breeding programs to produce progeny of specific types, in spite of the fact that most small grains are self-fertilized and hence are immune to the evil effects of inbreeding. On the other hand there has been a nearly universal assumption that desired types are to be selected from the F_2 progeny of matings of suitable parents. Recently there has been a wide-spread feeling that large numbers should be used.

The writers feel that there is an important place for back-crosses in small grain breeding that is not now fully appreciated. It must be acknowledged at the same time that the barley projects here discussed are not yet far enough advanced to be entirely satisfactory as examples. The results to date, however, are so promising and the method so plausible that others working with small grains may find it worth considering when breeding for definite ends.

Smooth-Awned Barley

One of the barley projects now under way is the production of varieties with smooth awns. This is of especial interest because both the large generation and the back-cross methods have been and are being tried. The extensive co-operative breeding work at the Minnesota Agricultural Experiment Station was carried on by selections in the F_2 and later generations. This work is being continued. At two other experiment stations the production of smooth-awned barleys is an important project. The production of high-yielding smooth-awned varieties is of much importance. The rough awns are objectionable both in harvesting the crop and in feeding the straw. They definitely limit the acreage of barley in places where the acre yield of feed from barley exceeds that of the crop grown in preference.

Several smooth-awned barleys have been imported into the United States. Most of these are black, six-rowed, hulled varieties. Crosses with these and the American commercial varieties were first made by the senior author in 1911 and 1912. In 1913 an F_2 population was grown at St. Paul, Minn., in co-operation with the Minnesota Agricultural Experiment Station. In later years other F_2 populations were grown and a large number of segregates tested. The crosses at St. Paul were with barleys of the Manchuria type. In the Western States, hybrids with the barleys adapted to arid regions were made. Although the stocks of smooth-awned barleys available for hybridization were inferior in yield to Manchuria or the Western forms, out

of a cross of smooth-awned × Club Mariout a smooth-awned segregate was found equal to the Club Mariout parent in yield. This work was done at Moro, Oregon, in co-operation with the Oregon Agricultural Experiment Station. At St. Paul, Minn., no segregates of the Manchuria × smooth-awn crosses have so far been equal to the Manchuria in yield. As the senior author has previously stated,[1] it is unlikely that a parent is ever exactly recovered among the segregates of a cross and it is probable that weaknesses not found in the Manchuria parent were present in all segregates tested.

In 1920 it occurred to the senior author that, as all that was desired was a smooth-awned Manchuria, this character could be effectively transferred to the best Manchuria strain by backcrossing. C. I. No. 2330 (Minn. No. 184), the best Manchuria selection developed by the Minnesota Agricultural Experiment Station, was used as the Manchuria parent. A white six-rowed smooth-awned segregate from a previous cross was used as the smooth-awned parent. This segregate was homozygous for smooth awns and was one of the best of those tested at Minnesota. It was already partly of Manchuria "blood."

In the winter of 1920-21 the parents were crossed in the greenhouse at Arlington Experiment Farm, Rosslyn, Va. The F_1 of this cross was grown at Aberdeen, Idaho, in 1921, where it was recrossed with C. I. No. 2330, the Manchuria parent. The recrossed seed was sown in the greenhouse in the fall of 1921 and the F_2 generation grown at Aberdeen in 1922. A smooth-awned segregate in 1922 was crossed again with C. I. No. 2330 and the resulting seed sown in the greenhouse. The status of this project today is shown graphically below.

Results Obtained to Date

Already the barley looks more like Manchuria than any obtained previously from other crosses. It has been obtained quickly and inexpensively, as the numbers used were very small. It is in a way a project where the breeding of resistance to diseases occurring in Minnesota has been a factor and where the actual work has been done remote from this environment. It will be interesting to note if resistance can be obtained under such conditions.

This opens the question of the relative value of the two methods of breeding. This in turn brings up the large question of the reason for the lack of complete success in the earlier attempts. In this case the object is to obtain a smooth-awned barley as good as Minnesota No. 184 (C. I. No. 2330). From the smooth-awned parent we want only the smooth awns. All the

Chart 1. Present Status of the Smooth Awned Barley Breeding Experiment.

Manchuria — Lion

homozygous segregate F_4 — Manchuria 184

F_1 — Manchuria

F_1 — Manchuria

F_1

F_2

Smooth awned segregate — Manchuria

F_1

[1] Harlan, Harry V. Smooth-awned barleys. *Journ. Amer. Soc. Agron.* Vol. XII, Nos. 6-7, 1920, pp. 205-208.

other characters, morphological and physiological, are desired from the Manchuria parent. How feasible it may be to secure by recombination the characters of a parent is difficult to answer. Inheritance studies necessarily involve characters that can be measured or evaluated. Most of these are morphological in nature. Occasionally a physiological detail of metabolism becomes evident through chance, as when anthocyan colors are formed. The number of variations in metabolism which are not thus revealed cannot even be guessed at, but must be large. We do know that variations in the protoplasmic complex are inherited. That the difference of the cell content of varieties is evidenced in many ways, such as the treatment necessary to coagulate the proteids of wort from barley, the variations in milling quality in wheat, and recently by the specialized forms of rust. Following the lead of Dr. Stakman, 37 specialized forms of stem rust now are known and the number seems limited only by the facilities for testing. These forms are largely differentiated by the reaction of different strains of wheat to them. This means that there now are known 37 different heritable protoplasmic complexes of wheat that have to do with rust resistance. It is probable that several times that number actually exist. There must also be many heritable variations of cell content not associated with rust resistance but associated with the vigor and yielding power of the plant and with the nature of the proteids in the grain which may be of importance in milling, malting, or other commercial use.

At any rate, in the mating of two parents there is an indefinite number of heritable physiological characters that will combine in an unknown number of combinations and the nature of these combinations cannot be determined by an inspection of the plants, as is the case with morphological characters. We are thus breeding for characters we cannot see and whose numbers we do not know. This brings up the question of probabilities. If we are dealing with an unknown number if invisible characters, what is the chance of securing a segregate that has all the Manchuria characters except roughness of awns? When our pathologists get under way on the leaf and root fungi detrimental to barley it is probable that they can equal in number the rapidly increasing parasites of wheat. When to the number of different protoplasmic complexes shown by disease susceptibility is added those differences which must be associated with other heritable qualities the number of non-visible factors may reach into the hundreds. If there were only 20, the breeding by the use of large numbers would be impossible, assuming that all 20 of the physiological characters of Manchuria are superior to those of Lion for conditions in Minnesota, and that these are inherited independently. There would be just one chance in 1,048,576 that the 20 desirable Manchuria characters would be found in any segregate and one chance in four that this segregate would be smooth-awned if found.

It obviously would be impossible to grow such a generation or to discover the desired plant if grown. On the other hand, in back-crossing, if the 20 characters are inherited independently, there is a rapid elimination of those coming from the Lion parent. With each recross the Lion "blood" is reduced one-half; in five back matings only one-sixty-fourth of the blood is not Manchuria and that one-sixty-fourth is heterozygous with only one chance in 128 of any one factor being finally other than Manchuria. That is, if there were 20 independently inherited factors the expectancy would be for 108 out of 128 plants to be entirely homozygous for Manchuria characters and the remaining 20 to be heterozygous for only a single character. It should be possible here to select the plant desired.

Linkage a Limiting Factor

These assumptions are based on independent inheritance. The assumption of independent inheritance is no more justified than the assumption of as few as 20 characters. It is probable that these factors are linked in groups and that the groups are fewer than 20 regardless of the total number of factors. This assumption, while decidedly influencing the results obtainable, does not change the method of procedure. If linkage is presumed, it is logical to presume that some of the objectionable characters of Lion are linked with the smooth-awned factor. If this is the case it limits the achievement of all methods of breeding and if the linkage cannot be broken down the best that can be achieved will be smooth-awned barleys homozygous for the factors of Manchuria except those with which the smooth awn is linked in Lion. This point, if it is the limit, should be more easily reached by back-crossing than by selection from an extensive F_2 generation.

There is no reason to believe that linkage is at all an insurmountable barrier. Other smooth-awned parents could be used in which more desirable characters might be linked with smooth awns than in Lion. Also linkage is far from absolute. In the continued back-crossing there is opportunity for cross-overs to break up the undesirable group. As the Manchuria parent is repeatedly used, cross-overs must include desirable characters, which is not necessarily the case in the later generations of the heterozygous elements of the cross when not back-crossed. In many plants the evidence of linkage is so slight as to indicate a very great number of cross-overs.

Whatever the explanation, it would seem that on this project the easiest approach to the point limited by linkage is by back-crosses and that the greatest opportunity for profitable cross-overs is afforded by the same method. In the smooth-awned project the smoothness of the awns is not being modified by the repeated back-crossing. The F_2 plant segregated out in 1922 had awns as smooth as those of the parent used in 1920.

The writers have one or two other breeding projects where the same method is being used and it would seem especially serviceable in such problems as changing the color of otherwise desirable varieties and in securing earliness while retaining the varietal characters.

Group, Race, and Nation

The Group Mind, a sketch of the principles of collective psychology with some attempt to apply them to the interpretation of national life and character, by William McDougall, F. R. S., Professor of Psychology at Harvard University. Pp. 418. New York, G. P. Putnam's Sons, 1920.

One of the distinguishing features of Dr. McDougall's extremely interesting book is the sound eugenic theory which runs through it. The eugenist must be profoundly concerned with many of the facts of collective psychology, since he is dependent on them to get carried into effect the principles which he realizes as essential in any permanent and good government. Dr. McDougall has, from the psychological side, made many helpful contributions to eugenics, and the present volume, which is a sort of sequel to his widely-known *Introduction to Social Psychology,* deserves wide reading.—*P. P.*

DIVERSITY OF INTERNODE INDIVIDUALS

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DATA of special value in the study of diversity may be drawn from plant life or from such lower animals as worms, millipeds, or centipeds, with the body showing numerous repetitions of the same organ. Dozens or hundreds of joints of a metamerous plant or animal body may follow each other as exact biological equivalents, and such series may be considered as the closest approach to uniformity in the processes of reproduction. Since the metamers are products of segmentation or vegetative growth, the problem of interpretation is greatly simplified. Many physiological and environmental complications attend sexual reproduction, with endless possibilities of confusion regarding the heredity of sexually produced individuals. The individuality of the vegetative internodes is of a lower order, but lends itself better to a determination of the question of diversity.

That internode members of the same plant are formed under the same conditions and are of the same heredity, is hardly to be questioned. At least, it will be admitted that the conditions of internode development are more alike in the same plant than can be asserted for different plants. Of course, the vegetative internodes may be specialized in various ways and degrees, as are the internode components of the flowers and fruits, so that numerous types of internodes may be distinguished among the internode members of a plant, but hundreds or thousands of examples of the same type may be available for comparison in a tree, shrub, or large plant.

Biological Duplication

Not only do successive internodes or leaves of the same vegetative shoot represent biologically the same thing, but comparison of the two halves of the same leaf or other symmetrical parts of the same internode individual gives even a sharper focus upon the question whether biological duplication or manifolding of the same structure is a process of mechanical exactness or may follow many alternative courses, with a resulting diversity of detail.

Whether we think of a transmitted "character" as a general "determiner" of leaf-form for the entire plant, or as restricted to a particular feature, or to an individual leaf, exact determination is hardly to be claimed when definite differences are shown by corresponding parts of the same leaf. (See figures 19 to 22.)

The meaning of such facts in relation to heredity depends, of course, on the assumptions that are made regarding the nature and number of the transmitted determiners or "genes." In proportion as fewer determiners are assumed for the transmission of the characters a wider range of diversity must be admitted in the expression or development of the characters, to account for differences among the internode individuals of the same plant. The course of internode development is not simple and direct, but divides and ramifies into the many alternative paths that are shown in the formation of the different types of internodes, as well as in the diversity of form that appears among the internode individuals of the same type. Even in the same leaf, diversity may be shown, when equivalent parts are compared.

The different types of internodes on the same plant may be as different as species, genera or families, or may be considered as analogous to the sexes, castes or other definitely diverse forms

DIVERSITY OF LEAF-FORMS IN PISTACIA

FIGURE 19. Leaves of the pistachio tree (*Pistachia vera*) at Sacaton, Arizona, October, 1922, all from the same tree as Figure 20, the three large leaves from the same twig. The typical leaf-form is shown at the lower right-hand corner, a leaf with two pairs of lateral pinnae which are narrowed abruptly to the point of attachment while the terminal pinna has a gradually narrowed or decurrent base. Leaves with only one pair of lateral pinnae often show a more abrupt narrowing of the base of the terminal pinna which in such cases probably indicates a complete fusion of the upper pair of lateral pinnae with the terminal pinna. Different stages of partial fusion are shown, as in Figure 20. Natural size.

DIVERSITY OF LEAF-FORMS IN PISTACIA

FIGURE 20. Leaves from the same tree as in Figure 19, showing intermediate stages between leaves with one pair and two pairs of lateral pinnae. The second pair of lateral pinnae often is fused more or less completely with the terminal pinna. The lower left-hand leaf shows partial fusion on one side and complete fusion on the other, as indicated by the very abrupt base, which is a character of the lateral pinnae. In the upper left-hand leaf the decurrent base character is shown in the lateral pinnae, one of which is separate and the other completely fused with the terminal pinna. Such fluctuating differences in leaf-form are of interest as showing that the processes of heredity are not exact, but result in normal diversity.

DIVERSITY OF LEAF-FORMS IN AGRIMONIA

FIGURE 21. Leaf of Agrimonia growing in partial shade at Lanham, Maryland, showing diversity among the pinnae, with many gradations in size, and irregular alteration of arrangement. Groups of one to four of the small pinnae alternate with the large pinnae. The larger of the small pinnae are generally at the intermediate positions, between the bases of the large pinnae, but these relations are not regular, nor are the shapes or the marginal notches of the pinnae.

DIVERSITY OF LEAF-FORMS IN AGRIMONIA

FIGURE 22. For comparison with Figure 21 to show the nature of the differences that commonly appear among leaves of the same plant. The rachis of this leaf is longer and the pinnae more slender and widely spaced, also differently graded in size, with some of the secondary pinnae relatively larger, especially on the left side of the leaf. Also the upper, left-hand pinna is decurrent at base, possibly as a result of being united with a small pinna.

that become established in many species. But in addition to these larger differences the internode individuals of the same type show a general diversity corresponding to that of individual plants or animals which are members of the same species. Thus the most direct indications of biological facts do not support the idea of definite paths of development, or of paths that are followed exactly. The inference is that diversity, rather than uniformity, should be considered as the normal product or manifestation of heredity. The different types of internodes of the same plant were considered by Goethe as an important evidence of evolution, and a like significance may be claimed for internode diversity in relation to heredity.

Having seen that the expression of characters is frequently and indefinitely varied in the development of the internode individuals, it seems not unreasonable to expect a similar variability in sexually produced individuals, and to consider such diversity as a result of normal reproductive processes. Goethe described the growth of internodes, one from another, as "successive reproduction," in contrast with "simultaneous reproduction" by sexual processes.

Notwithstanding the great advances that have been made in recent years in the cytological study of transmission and the mechanical explanation of the inheritance of Mendelian differences, there still is no conception of the nature of the characters, as showing how they are represented in transmission, or how they are brought into expression. Hence it is possible as yet to think definitely of characters only as they are brought into expression, through the development of the plant or animal individual. The results that are produced are the only basis of judgment regarding the nature of the reproductive processes, the transmission and expression of the characters.

A Survey of the Whole Field

Readings in Evolution, Genetics, and Eugenics, by Horatio Hackett Newman, Professor of Zoology in the University of Chicago. Pp. 253, with 101 illustrations; price $3.75. University of Chicago Press, 1921.

That this volume has passed through several impressions since its first publication, is good evidence that it meets a need of the collegiate world. It consists of extracts from the works of standard biological writers, living and dead, together with numerous introductions and discussions by Professor Newman, covering all the important phases of the subjects included in the title. The sections dealing with what are now more or less historical aspects of genetics are full enough to leave the uninitiated reader in some doubt, perhaps, as to just how far they have stood the test of criticism, and subsequent development of the subject. It is perhaps inevitable that some topics should be dealt with by writers who are by no means recognized as masters of them, though perhaps eminent in some other field of biology. Difficulties like these are certain to occur in any book made of selected readings, and if they require elucidation, the instructor will doubtless be able to supply it. On the whole, the book is probably the most useful single volume available to a reader seeking merely a brief account of all aspects of genetics.—*P. P.*

CULTURE OF CREPIS FOR GENETIC INVESTIGATIONS

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IN genetic investigations dealing with living organisms the problems of cultural technique are of prime importance. The methods must permit of facility and accuracy in manipulation and at the same time give equal and optimum conditions for the development of all individuals. In most breeding work, such technique is only developed after a period of trial and comparison by which unsuitable methods are discarded.

Preliminary experiments indicate that some species of the genus Crepis, particularly those with low chromosome numbers, give promise of becoming the means of inquiring into problems of cytology, the evolution of chromosome number, speciation, and heredity in plants. Since a number of inquiries concerning technique have been received it seems desirable to describe some of the cultural and hybridization methods which have been employed by the Division of Genetics at the University of California in preliminary experiments with Crepis plants.

The genus belongs to the chicory tribe or Ligulifloræ of the Compositæ which includes all those plants having a flower capitulum composed entirely of ligulate flowers. In *Crepis capillaris* each flower is perfect, 30 to 50 being grouped to form a single capitulum which when open measures about 20 mm. in diameter.

Although the cultural and hybridization methods reported here have been used on relatively few species, they may be adapted for use on any of the small-seeded plants of this group.

Germination of Achenes

The achenes are very small and the seedlings on first appearance may closely resemble those of some weeds, therefore, the method of germination must be so devised as to permit no uncertainty regarding the identity of the seedlings. This has been provided for in two ways, one of which is steam sterilization of the soil in shallow clay seed pans at 15 pounds pressure for 45 to 50 minutes. Before sterilization a piece of paper is tied over the top of the seed pans and it is not removed until the achenes are planted, thus eliminating chances of contamination if seeding is delayed for some time after sterilization. The achenes are sown in the pans and covered as in the usual practice for seeds of this size. About the time the second plumule leaf appears the seedlings are pricked out and planted in six-inch clay flower pots, or into smaller pots or flats, if the plants are to be grown as field cultures. In the second method the seeds are placed in a small moist-chamber germinator shown in figure 23, suitable for any number up to 100 achenes.

Glassware and paper should be sterilized to prevent the growth of fungi in the moist chamber. This latter method has an advantage over the sterilized soil by permitting inspection of the sprouting achenes, an accurate record of the percentage of germination, the examination of achenes that fail to germinate, and a record of the sequence of germination. As the achenes germinate they can be taken up with a fine pair of forceps and planted in pots or flats. In order to avoid injuring the tender seedlings by handling with the forceps, a small portion of the damp towel paper may be lifted with the seedling adhering to it. This fragment of paper is placed in the soil with the plant, the forceps not coming in contact with the seedling at any part of the process. Some achenes which remain

MOIST CHAMBER GERMINATOR

FIGURE 23. An easily made and efficient germinator for sprouting the delicate Crepis seedlings. It is made by folding a paper towel over a piece of flat glass and letting the ends dip into water. The seeds are covered with an inverted petrie dish.

for days in the germinator without sprouting can sometimes be made to do so by splitting the seed coat. The germinators should be placed in subdued light, inasmuch as the light tends to retard lengthening of the root and hypocotyl, making it more difficult to get the seedling into the soil properly. The intensity of the light may be reduced by placing over the germinators several thicknesses of newspapers. Under such conditions the hypocotyl elongates so as to facilitate handling and planting. The achenes will germinate under a wide range of temperatures but from 60° to 70° F. gives most satisfactory results.

With such small seedlings some difficulty may be encountered when the watering is done from above when either a hose or sprinkling-can is used, because of soil being washed over the seedling. This may be avoided by placing the pots in shallow pans which are then filled with water. The water enters the pot through the drainage-hole in the bottom and is carried upward to the surface by capillary movement. For the first few days the top of the pot may be covered with a piece of glass which will check surface evaporation. A relatively small number of pans may serve for a large number of pots inasmuch as the pot needs to remain in the water only ten to twelve hours to be thoroughly irrigated. The pans may then be shifted to serve in watering another group of pots. When the plants are about four or five weeks this sub-irrigation may be dispensed with.

For field cultures the seedlings can be placed in 2″ x 2″ x 2″ bottomless tar paper planting pots (obtainable at seedsmen's supply houses), and later, when the rosettes start to form, placed in the field rows; or the seedlings can be placed in flats without using the paper

pots. However, the later are more satisfactory.

Different forms of fungus may appear and grow very rapidly in the moist chamber of the germinator, the spores having been introduced with the achenes. Achenes are sometimes retarded or entirely prevented from germinating by the presence of fungi in the germinator. Although it is not always necessary, in special cases of limited supply of seed it may be desirable to treat the achenes to prevent fungus development in the germinator. Formalin vapor and calcium hypochlorite have been used effectively for this purpose, but any of the common methods of seed sterilization may be used.

Technique of Hybridization

The smallness and peculiar arrangement of the flower parts in Crepis require, for critical hybridization work, especially devised methods of manipulation. Mendel attempted some hybridization work on Hieracium, the flowers of which are essentially like those of Crepis. He found that the failure to secure a large number of hybrids was largely due to the minuteness of the flowers, to their peculiar arrangement, and to the fact that it was seldom possible to remove the anthers without injuring the pistil.

Although the flowers of *Crepis capillaris and C. tectorum* are no larger than those of Hieracium the difficulties mentioned by Mendel have now been largely overcome by growing plants in the greenhouse where humidity can be controlled, and by using especially adapted tools for the work. The most useful of these is a binocular magnifier, which can be attached in place before the eyes of the operator, thus leaving both hands free. Microscopes of this type can be obtained from optical companies.

In *C. capillaris,* the anthers are removed just before the flowers of the capitulum open, when the bud is about 7 mm. long. When the flower is fully open about half of this length is bent back so as to be in a plane at right angles to the pedicle. Individual flowers when fully expanded are from 10 to 12 mm. long. The length of the pistil is slightly less than that of the corolla. The stamen tube of a fully open flower is 3 mm. in length. The flower at the stage when emasculation is performed is but 5 mm. long. Flowers of the Compositæ have five anthers, which form a tube about the style, the pollen being shed on the inside of the tube. As the flower begins to open, the style elongates, pushing the two closely appressed stigma lobes upward through the stamen tube until they extend above it, when they spread apart and are later pollinated. The upper portion of the surface of the style and the outer surface of the stigmas are supplied with barbs pointing upward, which sweep the pollen out of the tube as the style elongates. The stigmatic lobes of the style usually remain together until the floret is fully open, and the style fully extended, thus preventing self-fertilization from taking place before there is a chance for cross-fertilization. If they fail to be cross fertilized, the stigmas curl in such a way that the receptive inner surface of the stigma comes into contact with its own pollen or that of an adjacent floret so that fertilization may result.

Two methods of pollen removal referred to in a previous paper (2) have been used. The first method consists in removing the pollen from the stigmas of the entire head, by forcing a fine jet of water over them from the nozzle of a small dental chipblower syringe, much after the method described by Oliver. Due to the fact that anthesis occurs progressively from outer to inner florets of the capitulum, this method was not satisfactory, because it would require close attention for a number of hours on several successive days to insure the removal of the pollen from all the florets.

A modification of the Oliver method has been devised which reduces the time and attention required for a given pollination, and with which the probability of self-pollination is reduced to a minimum. In this method only the outer whorl, containing about 20 florets

HYBRIDIZING TABLE

FIGURE 24. The support for the pot is adjustable, permitting the flower to be brought to any desired level. Much of the work with Crepis is of a very minute character, and a binocular magnifier that can be worn on the head is of great assistance. Crepis is of value to the student of heredity because of the small number of chromosomes its cells contain, making a study of the location of hereditary characters within the chromosome a relatively simple matter.

A CREPIS FLOWER

FIGURE 25. Only the outer whorl of florets has opened. At this stage pollen would be removed from the anthers and the unopened florets would be pulled out, if this flower were to be used for hybridization experiments. Greatly enlarged.

is utilized, the rest being pulled out with a pair of fine pointed forceps before anthesis takes place. The efficiency of the improved water depollination method has been well demonstrated in attempts to cross species of which the female, at least, is self fertile, but sets no seed after pollination with foreign pollen. Heads not depollinated set seed abundantly.

Anthesis occurs during definite intervals of the day. In the species under discussion from three to five days are required for all of the flowers of a capitulum to open. The outer whorls of florets become active first; the others follow in order from the outer to the innermost. During clear warm weather anthesis of a whorl of florets commences before seven o'clock in the morning and ceases about half past eleven the same morning. It is first evidenced in a bud by the rapid elongation of the outer whorl of florets. They remain at the maximum elongation for a short period and then rapidly open. Activity in the process of anthesis apparently is suspended during the afternoon and until about the same time the following morning when it is renewed. During this period of suspended activity the florets tend to remain in whatever stage they happen to be until the active period of the next day. Thus sometimes only a few of the florets of the first whorl expand during the first active period, the rest remain inactive until the following day. Similar behavior has been noted by

BEFORE AND AFTER DEPOLLINATION

FIGURE 26. Two Crepis florets greatly enlarged, showing the effect of the water depollination process.

Fruwirth in the common chicory, *Cichorium Intybus.*

Weather conditions may cause a variation in the time of these periods of anthesis activity. They are more clearly defined during clear sunny days than during cloudy days. Opening of the florets takes place during the forenoon and fifteen to twenty florets (those of the outer whorl) develop first, while the remaining inner florets show no activity. Hence with the improved water depollination method the pollen can be washed from the stigmas of the outer whorl of florets before the stigmatic surface is exposed. The central florets, which have not yet begun to open are then pulled out. From one to three days later pollen may be applied to the exposed stigmatic surfaces of the depollinated florets and the heads enclosed in a paper bag. Usually, however, the head is again pollinated on the two succeeding days to insure fertilization. This method has given satisfactory results.

Another method used for the most critical hybridization work is the actual removal of the undehisced stamen tube from the unopen floret. This operation is performed under a binocular magni-

fier giving a magnification of three to five diameters. A larger magnification might be desirable, but to secure this would mean a reduction of the working distance and a finer adjustment of focus making it very difficult to perform the work with the binocular worn on the head of the operator. The involucral bracts which inclose the florets in the bud stage are bent down and held out of the way during the operation. The back (or under) side of the corolla thus exposed is slit almost its entire length using a dissecting needle having a very small sharp pointed hook at its tip. The stamen tube is likewise split, often at the same time that the corolla is opened. With the hook at the point of the needle the split stamen tube is pulled from its position surrounding the style, the upper end is grasped with finely pointed forceps and removed by a gentle upward pull. The operator can, after a little practice, perform this without breaking the anther tube, as the fine filaments will break before the stamen tube itself. Some of the pollen grains may adhere to the style, and to remove these the emasculated flowers are flushed by a stream of water as in the water depollination process. Ordinarily only the peripheral whorl of florets are emasculated, the remainder, because of their greater inaccessibility and immaturity, are pulled out. The bracts of the involucre are then folded over the florets and the head enclosed in a small bag.

When the florets have opened from one to three days later, the heads should be carefully examined for any unemasculated florets which may have escaped removal. If any open florets are found, the entire head should be discarded; if none are found, pollen is applied by brushing the anthers of a previously bagged pollen plant over the receptive stigmas of the emasculated florets. It may be desirable to modify this procedure to take advantage of some particular characteristic of some of the other Crepis species. Thus in *C. rubra* it is sometimes possible to remove both corolla and stamen tube at one operation by grasping the upper end of the ligule at an early stage of anthesis and pulling upward steadily and slowly. These parts are detached from the achene and come off leaving the style free of pollen and the stigmatic surfaces still unexposed. For the emasculation work the ordinary dissecting needles and forceps are very much too coarse and blunt. If satisfactory tools cannot be purchased they can be made by grinding down the points, and finishing them under a binocular in order to secure a fine smooth point on the needles and perfect alignment to the tips of the forceps.

To facilitate the emasculation work, a table has been designed with arm supports similar to the arm supports of a dissecting microscope and an adjustable support for the potted plant which may be raised or lowered so that the buds of the plant can be brought to the level most convenient for the operator.

Abundant pedigree seed of the self-sterile or partly self-sterile species and biotypes may be best secured by dusting the pollen of one plant onto the stigmas of another of the same strain. Some of the strains, due to a high percentage of self-sterility can only be maintained in this way. Self-fertile plants may be protected in the field by using a cheese cloth covered box, but this method is rarely satisfactory for the greenhouse. Semi-transparent waxed paper bags are more desirable than opaque fibre bags. The achenes mature from 3 to 4 weeks after pollination and can be made to germinate without a rest period.

Parasitic Organisms

Crepis plants may become infested with parasitic organisms common to greenhouse and cultivated plants and these may be eradicated by the usual methods. During damp, cloudy or rainy weather the greenhouse cultures may be attacked by a fungus (*Botrytis cinerea*) causing damage to foliage and frequently causing death of plants. Reduction of atmospheric humidity seems to be the most effective way to combat the spread of this fungus.

Literature Cited

1. Babcock, E. B. Crepis, a promising genus for genetic investigations. *American Naturalist,* LIV: 270-276. 1920.
2. Babcock, E. B. and J. L. Collins. Interspecific hybrids in Crepis *I. Crepis capillaris Wall.* x *C. tectorum* L. University of California Publication in *Agricultural Science* II: 191-204. 1920.
3. Fruwirth, C. Handbuch der landwirtschaftlichen Pflanzenzuchtung. Band II. Berlin. 1918.
4. Mendel, G. Cited by W. Bateson. *Mendel's Principles of Heredity.* N. Y. 1913.
5. Oliver, G. W. New Methods of Plant Breeding. *Bulletin No.* 167, U. S. Department of Agriculture. 1910.
6. Wilson, James K. Calcium hypochlorite as a seed sterilizer. *Am. Jour. Bot.* II: 420-427. 1915.

MEMORIAL TO JAMES REID

Originator of "Reid's Yellow Dent," the Most Valuable Type of Corn Ever Produced

Members of the American Genetic Association will be interested to learn of the formation of the "James Reid Memorial Association."

The objects of the association are to honor the memory of this great plant breeder and to provide a fund for the relief of his wife and daughter who are in need.

The plan provides that after their death the fund, to be known as the "James Reid Fellowship Endowment," shall be intrusted to the University of Illinois and the proceeds of which are to be used to encourage research work on corn.

"Reid's Yellow Dent," the variety developed by Mr. Reid, is believed to be the most valuable strain of corn that has ever been produced. The initial steps in the production of this variety were taken by Mr. Reid's father, who began the work by crossing two distinct varieties of yellow corn. From the results of this cross Mr. James Reid by years of patient selection produced the variety that proved to be well adapted to a wide range of conditions and has served as the foundation of a host of local varieties. The type was so prepotent that in spite of hybridization and selection to meet varying conditions the results of Reid's work are still plainly evident in a large part of the yellow corn now being grown.

Those wishing to add to the fund may send their contributions through the American Genetic Association, Box 354, Pennsylvania Avenue Station, Washington, D. C.

The

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ASTYLIS AND ORBICULARIS PHLOX

FRONTISPIECE. As an illustration of how genetics enables us to analyze the hereditary make-up of living things this study of inheritance in phlox is instructive. The small, white-flowered, *astylis* form was found in a supposedly pure strain of small-eyed phlox (Figure 1), and also appeared on inbreeding the large-eyed *orbicularis* variety. Crosses were then made between *astylis* and small-eye and the plants of this first hybrid generation were all of the *orbicularis* type. That is, small-eyed and *astylis* are genetically pure strains, which normally would be expected to breed true (if *astylis* were not self-sterile), while *orbicularis* is of hybrid origin, containing the genes *astylis* and small-eye in the heterozygous condition. The hereditary determiner of the small-eyed character is only partially dominant over *astylis*, and the *astylis* "blood" has the effect of inhibiting the development of anthocyan color except in the periphery of the petals.

ASTYLIS PHLOX

The Relation of This Variation of Phlox Drummondii to the Large-Eyed Flower[1]

JAMES P. KELLY

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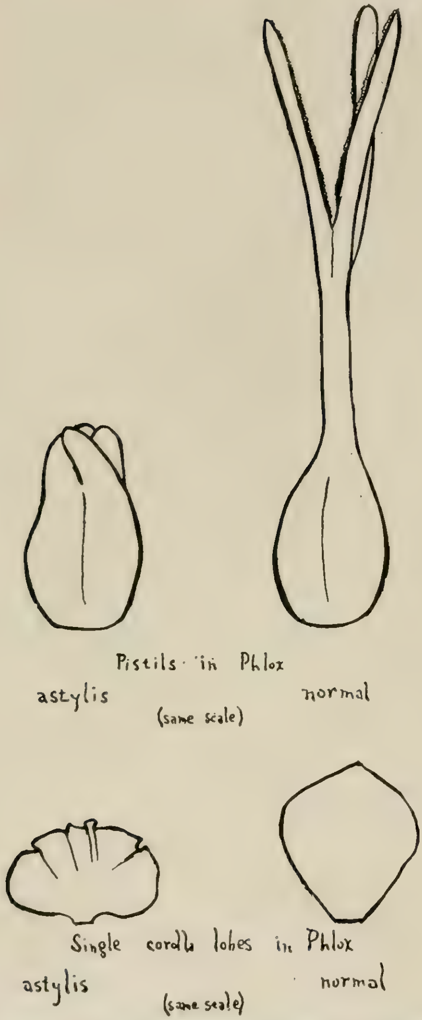
SMALL-EYED PHLOX

FIGURE 1. Pure strains of small-eyed phlox are easily produced by the breeder, but this is not possible with *orbicularis,* for a study of its genetic constitution proves it to be of hybrid origin. Three types of plants, having *orbicularis, astylis,* or small-eyed flowers, are produced by self-fertilized *orbicularis* seed, but the cross between *astylis* and small-eye produces only *obicularis* plants.

IN 1920 there appeared in some cultures of Drummond's phlox grown from German seed a striking and unexpected type of flower. It cropped out in two individuals of a variety supposed to have only normal pink flowers with a small white center, or eye. The new type of flower was exceptionally small, entirely white, and with ruffled or wavy corolla lobes of relatively great width. Closer examination revealed that while pollen was present in normal abundance the style was totally lacking, hence the name *astylis* bestowed on this variation. (See Frontispiece). Repeated hand pollinations were tried on the *astylis* individuals but not a single seed was formed, and experience of subsequent seasons with other *astylis* plants has confirmed the fact of sterility as far as the ovary is concerned. Fortunately, *astylis* pollen is viable and some crossings in which it was used proved successful.

At the time that the *astylis* plants were discovered the writer had under observation two plants of the *orbicularis* type of *Phlox drummondii.* (See

[1] Contribution No. 40 of the Botany Dept., Pennsylvania State College.



NORMAL AND ASTYLIS PISTILS AND COROLLA LOBES

FIGURE 2. *Astylis* plants are sterile because the ovary is undeveloped. Fortunately, the pollen is viable, and crosses with other kinds of phlox can be made. The self-sterility of *astylis* makes it impossible to raise pure *astylis seed.*

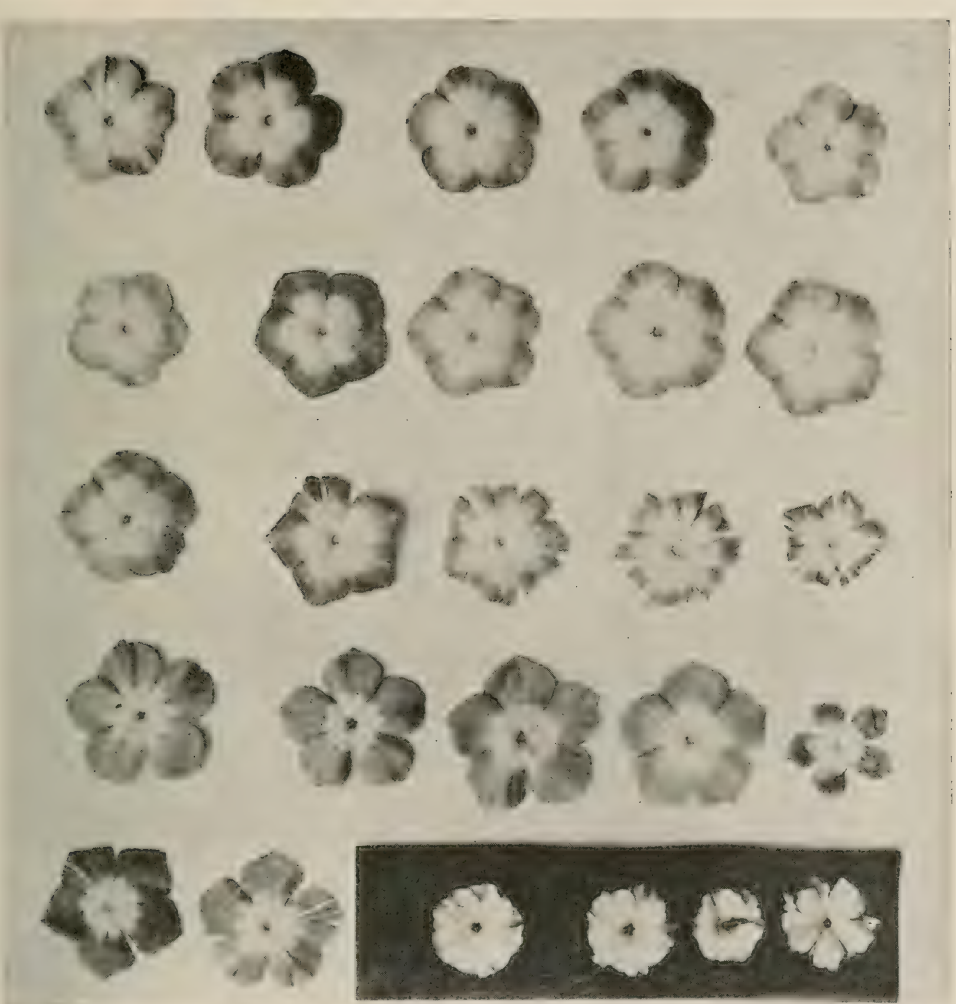
Frontispiece.) The flower in this form is normal, particularly as regards style development, and is distinguished by having the anthocyan pink color more nearly confined to the periphery of the corolla than in any other phlox. The center of the flower is occupied by a relatively large white eye. The genetic analysis of this large eye was undertaken and both self pollinated seed and crosses with other varieties were obtained.

The Origin of the Orbicularis Variety

It was not expected at the time that the paths of investigation of *astylis* and of *orbicularis* would converge and become one, but observation very soon revealed *among the progeny from self-pollinated orbicularis more of the peculiar astylis plants.* These new *astylis* individuals had as sibs large-eyed plants, just like the orbicularis parent, and also small-eyed ones, both kinds bearing normal styles as far as observed. *Orbicularis,* then, on inbreeding, besides having reproduced itself, produced *astylis* plants, and a small-eyed kind as well. Furthermore, it was found that when a plant whose flowers have a small white eye with a wide colored periphery was crossed with *astylis* the progeny all have flowers with large white eyes and narrow periphery; *i. e., the* F_1 *hybrid generation of small-eye and astylis is orbicularis.* Two such crosses have been made giving rise to a total of nineteen progeny—uniformly *orbicularis.*

Five crossings of *orbicularis* plants and small-eyed ones have been made. There resulted 32 offspring of which twenty had the large white eye and twelve the small white eye.

From the *orbicularis* plants, including both the original commercial ones and those experimentally produced, 14 families have been secured through self-pollination. The total of progeny was 351, of which 84 were *astylis,* and 156 *orbicularis,* while 106 had small-eyed flowers. Five non-*astylis* plants were left unclassified because the eye was intermediate in size. *Astylis* segregates being sterile, could not be further tested by selfing. Three of the small-eyed segregates arising in the experiments gave on selfing 56 progeny of which 55 were small-eyed and one (a stray seed?) had a large eye. Small-eyed phloxes not included in the present



PROGENY OF AN ORBICULARIS PLANT

FIGURE 3. Each of the twenty-six flowers is typical of the plant from which it came. Note practical absence of anthocyan color in the four *astylis* flowers. In this family the small-eyed and the *astylis* plants (if *astylis* were not self-sterile) would be expected to breed true, whereas the progeny of the *orbicularis* plants would split up again in the next generation much as has been the case above.

study have long been in pedigree cultures of the writer and have never been known to throw anything but small-eyed plants.

It seems, therefore, that the *astylis* condition is dependent on a single recessive gene for its manifestation. There is a group of associated characters apparently due to this single factor. When in homozygous condition there follows an inhibition or loss of the style, reduction of the stigmatic branches, increase in the relative diameter of the corolla lobes, ruffling of corolla lobes, and decrease in the size of the flower. The existence of the large-eyed condition is due to this *astylis* gene in heterozygous condition. It converts the small-eyed flower into the large-eyed kind by limiting the develop-

PLANTS OF THE THREE TYPES

FIGURE 4. The effect of the *astylis* gene seems to be to inhibit the development of anthocyan color in the central "eye" of the flower, when in the heterozygous condition, and to result in the development only of this "eye" region of the petals when it is in the "pure" or homozygous state. Note that the size of the *astylis* flower is approximately that of the "eye" region in the *orbicularis* form.

ment of the anthocyan color in the corolla to a narrower peripheral ring. curiously enough, the large white eye is not brought out when the *astylis* gene is homozygous. It seems then to cause the cutting off from development of the corolla periphery, the part that would show the blade color, leaving merely the large white eye; hence, too, the small size of the flower blade. A white *astylis* bloom may be looked upon as just the eye region of a flower with large white eye that has lost its periphery due to the absence of the gene. Figure 3 represents one entire family secured by inbreeding an *orbicularis* parent whose large white eye was surrounded by a Tyrian-pink border. All the non-*astylis* plants have borders of this color, but the *astylis* sibs of these colored plants are white or practically so. Occasionally a faint fleck or tinge of anthocyan may be detected on such plants.

Is it possible to interpret this situation on the basis of a close linkage of factors for white and *astylis?* Certain details of the experiments make this proposition unlikely. Some of the *orbicularis* plants of 1921 were heterozygotes of white and cream.[2] The cream had been introduced through a normal non-*astylis* parent. In 1922 six such heterozygous *orbicularis* plants gave 218 progeny as shown in the accompanying table.

These data indicate no linkage of white and *astylis*.

The large-eyed condition found in the variety *orbicularis,* therefore, is a heterozygous character and presents a genetic situation similar to that already reported by the author for the *fimbriate* phlox.[2] One could not expect to secure a true-breeding strain of *orbicularis* with the existant genetic constitution of *Phlox drummondii,* but this investigation shows that stands which are one hundred per cent *orbicularis* may be obtained by hybridizing *astylis* and the small-eyed variety.

TABLE I. *Distribution of the Progeny of Six Orbicularis Plants.*

Astylis		*Orbicularis*		*Small-eyed*	
White	Cream	White	Cream	White	Cream
40	10	80	24	49	15

[2] The writer has already shown that cream is a simple recessive of white. See *Genetics, V;* 189-248.

AN HISTORIC SPOT FOR STUDENTS OF GENETICS

J. C. Theodore Uphof

Orlando, Florida.

THE PRIMROSES OF SPANDERSWOUD

Figure 5. About 1885 this was a neglected potato field, and here Hugo de Vries discovered the mutant form of the Evening Primrose, on which he based his theory of evolution by mutation. Since that time the forest of beech and spruce trees has grown up and nearly wiped out the Oenotheras. In 1921 only a few were left and the shade was so dense that photographs were impossible. The pictures shown here were made in 1908, and as far as known, are the only ones published of this interesting place.

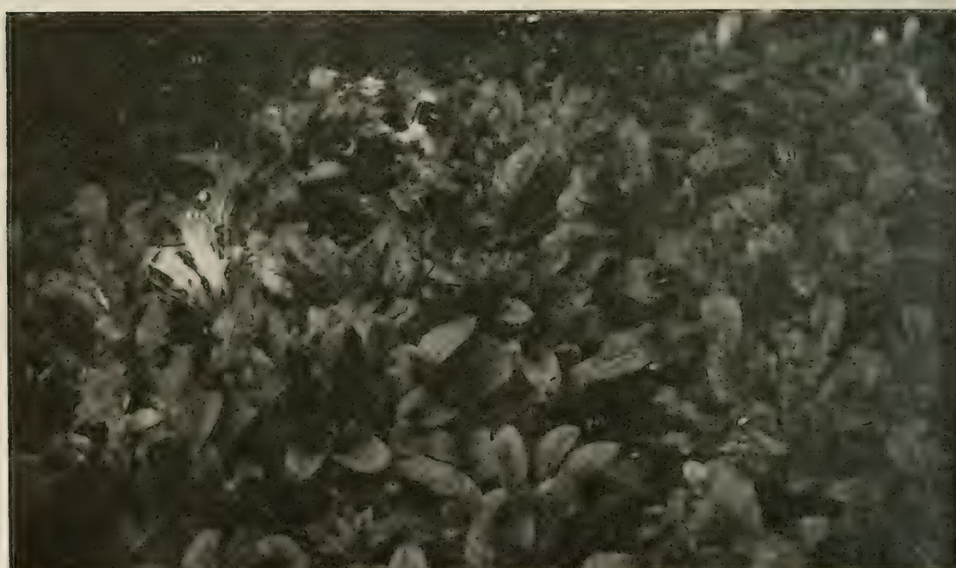
NOT far from Amsterdam, a road branches off to the westward from the highway between Bussum and Hilversum. It leads through sandy fields and pine forests to the region of the lakes of Ankeveen. Passing through the old Dutch private estates of Swanenburg and Boekenstein, surrounded with beautiful gardens and woods, the traveller reaches Spanderswoud, one of the largest estates in that part of the country. It was here in 1886 that Hugo de Vries found the first mutating Oenotheras, which were so important in the upbuilding of his theory of mutation.

According to de Vries, the Oenotheras were found in a neglected potato field, where they grew abundantly. The writer visited this place repeatedly between 1904 and 1908 and found it largely covered with a mixed forest of beech (*Fagus sylvatica*) and spruce (*Picea excelsa*). The forest was about fifteen years old, but some patches of *Oenothera lamarkiana* were still to be found in the open places.

Among the several thousand plants of the mother species there were but few of the forms to which de Vries gave the name *O. nanella.* In the autumn, when only the leaf rosetts were

A MUTANT ON ITS NATIVE HEATH

FIGURE 6. Three rosettes of the normal *O. lamarkiana* are shown, and in the right foreground is one of the mutants, a tiny plant of the type called *O. nanella* by de Vries.



THE FOUNDATION OF A GREAT THEORY

FIGURE 7. Even should de Vries' theory of evolution be finally discarded by students of biology, there could be no doubt of the value of his researches. They gave the impetus so much needed to make the study of evolution an experimental rather than theoretical science. Great strides have been made in our understanding of heredity and evolution, until now we have reached the paradoxical position of realizing how little we really know about this most interesting of subjects,—the scientific study of life itself.

to be found, I observed sporadic individuals of the minus mutant, so different from the typical *lamarkiana* in leaf form. Figure 6 shows in nature rosettes of *Oenthera lamarkiana*, between which a mutation, *nanella*, is growing. This plant was removed to my garden near Amsterdam, where it flourished and produced seed. Its offspring were all dwarfs, which emphasized de Vries' observation that *nanella* is one of the most constant of the mutants.

Between 1910 and 1921 the beech and spruce trees increased considerably in size, whereas the Oenotheras decreased in number so greatly that it appears that they will become extinct in a few years. It was practically impossible to get photographs of the few remaining specimens, therefore the accompanying photographs are those of the plants found in 1908.

As far as I am aware, no photographs have ever been published of this historical and remarkable place, the starting point for investigations which have figured so conspicuously in modern discussions of the origin of new forms of living organisms. To students of genetics it may be especially interesting to have these pictures reproduced during the month of February, when Hugo de Vries, the founder of Experimental Evolution, reaches the seventy-fifth anniversary of his birth.

No doubt all geneticists agree that Dr. de Vries' theory and researches of evolution have thrown a powerful beam on the phenomena of the origin of species. His brilliant discoveries and his revival of Mendel's researches have stimulated scientific investigation and laid the foundation for much successful work in plant and animal breeding.

Hybrids and Mutations of Campanula

INTERESTING results are reported by Lathouwers for experiments with *Campanula medium.* Hybrids between rose colored and white flowered varieties gave in the first generation dark violet-colored flowers, and in the second generation five classes of flower color are reported, white, rose, dark violet, violet, and lilac in various proportions. These results were difficult to understand, but were finally adjusted to Mendelian theories by assuming four genetic factors. A basic color factor, and a "revealer" must both be present to produce color. A third factor is supposed to determine alkalinity, and to be responsible for violet or dark violet instead of rose or lilac. The fourth factor is assumed to be an intensifier, changing violet into dark violet or rose into lilac.

When the third factor is absent a form called *monantha* appeared, considered to be a true mutation. It is characterized by a large solitary flower, with no lateral flowers or branches. Suddenly in a pedigree culture after two generations of self-fertilization the mutation was represented by eighteen individuals, while seventy-five other plants retained the normal form. This same mutant form appeared in later generations, and came nearly true to seed. Crosses were also made with this and other floral abnormalities.[1]

[1] See LATHOUWERS, M. V. Researches Experimentales sur L'Heredité chez *Campanula medium L.* L'Academie Royale de Belgique. No. 1283. 1922.

GLANDS AND PERSONALITY

A REVIEW

The Glands Regulating Personality, *by* Louis Berman, Associate Professor of Biological Chemistry at Columbia University. 300 pp. Price, $2.50. The Macmillan Company. New York, 1922.

Dr. Berman seeks in this book to point the way to the regulation of personality. He is deeply imbued with the idea that traits of character, disposition, our transient moods, are the expression of the process of secretion of these glands. "What in our cells is pugnacity? What in our bones is greed? What in our blood is sex? What in our nerves is fear? Until these inquiries are respected, conscious character building or even stock breeding must remain the laughing stock of the smoking rooms and the regimental barracks." Speaking of the glands of internal secretion, "In short, they control human nature and whoever controls them controls human nature."

The author gives a most interesting historical account of the studies upon the endocrine glands, and then takes up each in turn and gives pithy, epigrammatic characterizations of them. "It is . . . permissible to think of the thyroid as a dictator of evolution, to crown it as the vertebrate gland *par excellence* and to call the typical vertebrate brand-marks secondary thyroid characteristics in precisely the sense of Darwin classing the horns of cattle as secondary sexual characteristics."

Functions of the Glands

In dealing with the pituitary gland, he distinguishes only two portions—the anterior and posterior. Really the matter is more complex, since the part that he designates the anterior lobe is made up of three different elements, at least two of which have entirely distinct functions. In a summary statement, he says, "while the thyroid increases energy evolution, and so makes available a greater supply of crude energy by speeding up cellular processes, the pituitary assists in energy transformation, in energy expenditure and conversion, especially of the brain and of the sexual system. In short, the thyroid facilitates energy production, the pituitary its consumption."

In discussing the well known distinction between the cortical and medullary portions of the adrenal gland, he makes the statement that the cortical portion is relatively larger in man than in any other animal. Upon this claim and from asserted cases of abnormal development, he draws the rather bold conclusion that "the human brain therefore owes its superiority over the animal brain to the adrenal cortex, in development anyhow. The growth of the brain cells, their number and complexity is thus controlled by the adrenal cortex."

Of the thymus gland he says, "The thymus is the gland which dominates childhood. It appears to do so by inhibiting the activity of the testes and ovaries. Castration causes a persistent growth and retarded atrophy of the thymus. Removal of the thymus hastens the development of the gonads." He lays much stress upon the experiments of Gudernatsch in which he claimed that he had retarded development toward maturity in tadpoles by feeding them thymus material. This experiment, however, has not stood the test of repetition in later experiments by Swingle, Uhlenhuth and others. We must frankly admit that we have as yet no reliable knowledge of the function of the thymus gland—today we are more in the dark about it than ever. This is an example from many that might be chosen to illustrate the

tendency Berman shows to make far-reaching generalizations upon an insecure foundation of scanty, conflicting evidence.

Berman, in his treatment of the pineal gland, is even less justified from the evidence in hand, saying, "The pineal, the ghost of a once important third eye at the back of our heads, still harks back in its function to a regulation of our susceptibility to light and its effect upon sex and brain. So it becomes one of the significant regulators of development, with an indirect hastening or retardation of puberty and maturity according as it works in excess or too indolently." This seems to be a very rash statement indeed in the light of our present scanty knowledge of the function of this gland.

Types of Personality

Berman assigns the majority of human personalities to one of three principal types.

A. Thyroid centered type—Bright eyes, good, clean teeth, symmetrical features, moist, flushed skin, temperamental attitude toward life, tendency to heart, intestinal, and nervous diseases.

B. Pituitary centered type—Abnormally large or small size, musical, acute sense of rhythm, asymmetrical features, tendency to cyclic or periodic diseases.

C. Adrenal centered type—Hairy, dark, masculinity marked, tendency to diphtheria and hernia.

"These are some of the master types. They have their variants depending upon the influences of the other glands, especially the interstitial glands".

"We know also that the thyroid dominant tends to be irritable and excitable, the pituitary deficient to be placid and gentle, the adrenal dominant to be assertive and pugnacious, the thymus-centered to be childish and easy-go-lucky and the gonad deficient to be secretive and shy. This brings us to the relation of the internal secretions to the type of personality as a whole". This is a typical passage showing how he attempts to explain very complicated conditions in a word. Such sweeping statements seem quite unwarranted in the light of our present knowledge, although we can appreciate the grain of truth in each assertion.

The chapter on the sex-glands is presented in striking fashion and contains a large amount of information in small compass.

It is hard to believe with our author when he says, regarding the adrenal gland, "all evidence points to its medulla as the secretor of the substance which makes for the phenomena of fear, and to its cortex as dominant in the reactions of anger." This seems to be carrying things a bit too far.

Examples from History

It is in the characterizations of personages of history that Berman makes some of his most striking statements and departs most widely from serious science to wander in the realms of phantasy. Napoleon was "a pituitary centered, ante-pituitary superior, post-pituitary inferior, with an instability of both that would lead to his final degeneration. Besides his insatiable energy indicated an excellent thyroid, his pugnacity, animality and genius for practical affairs a superb adrenal."

Nietsche's character is explained as "pituitary centered, with post-pituitary domination, a superior thyroid and inferior adrenals". Darwin "had poor adrenals, superior pituitary ('the nidus of genuis') and an overacting thyroid." Caesar showed "a most delicate balance between his ante-pituitary, post-pituitary, adrenals and thyroid". "That his thyroid functioned well can be deduced from a career which involved more than three hundred personal triumphs." "The masculine love of glory and ambition, expression of a well working ante-pituitary, was combined with the effeminate echoes of an equally well evolved post-pituitary." "He was a rather muddled careerist because he

had too much adrenal and post-pituitary." Dr. Berman deals with Florence Nightingale and Oscar Wilde in equally assured fashion.

Under the heading *puericulture,* he says, "periodic, seasonal and critical fluctuations in the equilibrium among the hormones will have to be taken into account in the explanation of what have hitherto been put down to laziness, naughtiness, stupidity, or obstinacy."

Biologists will hardly agree with Berman that "The feeding of thyroid to a gifted father before procreation might enhance immeasurably the transmission of his gift as well as of its intensification in his offspring."

Of the book as a whole, it contains a large amount of information and is written in a most fascinating style that will make a strong appeal to the non-scientific public. Dr. Berman has made a most readable book, but in achieving this end he has thrown scientific sobriety and caution to the winds. The book is largely a romance that reminds one of such books as Moore's *Utopia.* It is true that in a book written for the general public one can not expect a full discussion of the various discordant opinions, but one has a right to expect that the author shall hold himself to the statement of facts reasonably well attested by scientific investigation. Dr. Berman too often accepts the wildest speculation and presents it as solid fact. He makes a facile analysis of the personalities of historic characters upon the basis of their endocrine makeup. No one can deny that the glands of internal secretion do profoundly influence personality—this having been especially well demonstrated in the case of the germ glands. While all this is true, at the same time, a hundred years of painstaking experiment will be required to give us a fairly satisfactory insight into the truth or falsity of the statements that Dr. Berman makes without the slightest qualification.

While this book will undoubtedly arouse a large amount of popular interest in the glands of internal secretion, it is greatly to be feared that it will mislead the public upon many vital points. It is quite certain that people are induced by it to expect entirely too much from the medical profession along the lines indicated. While such books as this will arouse a sensation it is much to be feared that the disillusionment that is bound to follow will react unfavorably to science and to medical practice.

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University of California.

The Facts of Social Hygiene

PLAIN FACTS, *by* J. H. KELLOG, M. D., Chief Medical Director of the Battle Creek Sanitarium. 2 vols., pp. 932, with numerous illustrations. Battle Creek, Mich., Modern Medicine Publishing Co., 1921.

In these comprehensive volumes (first published in 1917) Dr. Kellogg not only deals with almost the whole of the great field of social hygiene, but introduces a large amount of valuable instruction in physiology and hygiene at the same time. On sexual questions the author's point of view may be described as old-fashioned—which will be an unfavorable criticism in the minds of some, a commendation in the minds of others. A sound eugenic outlook is maintained throughout. Insistence is laid on the importance of heredity but the charts (based on eye color in man) to illustrate Mendel's Laws, will be misleading to those who have no previous knowledge of the subject.—*P.P.*

DUCTLESS GLANDS AND DEVELOPMENT

Amphibian Metamorphosis Considered As Consecutive Dimorphism, Controlled by the Glands of Internal Secretion

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A GREAT deal of work has been done on the problem of Amphibian Metamorphosis since the discovery of Gudernatsch[10]* that a thyroid diet caused precocious metamorphosis. It is not my purpose here to summarize this work, but to try to set out the problem in the most general light possible, and to draw attention to parallels with other lines of work which seem to promise fruitful results. Especially I would like to draw attention to Amphibian Metamorphosis as offering unequalled opportunities for studying developmental physiology from a rather new angle.

It is clear today that the thyroid plays a predominant role at metamorphosis with the pituitary as junior partner; but further than this it has been difficult to penetrate. There are two main problems which have attracted attention. The first may be summed up in a question: Why does the thyroid act at metamorphosis and not before? Young tadpoles of Anura long before metamorphosis have a well-developed thyroid, as does the facultatively neotenous Siren.[14] Why is it that the thyroid in these cases does not produce its characteristic effects? And how is it that in some species of Anura metamorphosis occurs within a few months, in others, as in bull-frogs, only after two or three years?

The second problem is equally general. Granted that the thyroid does produce metamorphic effects, how does it do so? Why does thyroid feeding not produce metamorphosis in permanently neotenous species such as Necturus?[14, 21] Why do certain tissues, such as the gills and fins, react to thyroid treatment by regression and resorption, while others, such as the legs of Anura, by active growth? Why, further, do similar tissues, such as the limbs, behave differently in Anura and in Urodela? If a certain amount of thyroid be necessary for growth in human beings, as is shown by the bad effects of congenital lack of thyroid in cretins, how is it that thyroidectomised tadpoles show a perfectly normal or indeed accelerated growth rate?

In regard to the second point, most authors, if they discuss it at all, agree that the changes in the larval organs at metamorphosis are of a similar kind to those seen in dedifferentiation of whole animals (e. g. Clavellina) or in involution of organs. Something occurs which affects these particular issues so that they can no longer remain functional.

The first point has hardly received the attention it deserves. The only hypothesis, so far as I am aware, which attempts to deal with the matter, is that which in various forms is advanced by Uhlenhuth,[22] Swingle[21] and others. It is that during the larval period the function of the thyroid is purely one of storage, but that just before the time of metamorphosis, a change occurs in it, and it starts to excrete its stored products, which only then can affect the body and so bring

* For numbered references see "Literature Cited" at end of article.

about metamorphosis. Uhlenhuth believes that a definite "excretor substance" is produced in some organ of the body as the result of general somatic differentiation, and that this affects the thyroid and causes it to liberate its secretion.

This, I must confess, appears to me to give no more than a formal explanation of the phenomena, and, furthermore, to be unnecessarily complicating matters. I may be pardoned if I digress for a few moments to another field for illustrations which I believe will throw light on the problem.

As is well known, Goldschmidt[8] has made a careful study of the sexually abnormal individuals produced by certain crosses between the European and Japanese races of Lymantria, the Gipsy Moth. He showed by a careful analysis that they could only be explained as individuals which have begun their lives as members of one sex, but had, at some time in their development, come to a critical point after which they continued to develop as members of the other sex. The commonest types of abnormal individuals are those which start as females, but finish as males. Since the chitinous hard parts of an insect are permanent, those which are laid down during the "female" part of the development persist even after "male" development has begun. Soft parts, however, such as the gonads, undergo a reconstructive process. If the critical point occurs early, before the formation of any chitin, complete sex-reversal takes place, and all individuals produced are of one sex.

Analysis shows clearly that this type of sexual abnormality, whether it leads to complete sex-reversal, or to the intermediate condition of intersexuality, is due to the association of genetic sex factors of different "strength" or "potency." It is further clear that in moths, the male-determining factor is lodged in the sex-chromosome, so that the males possess two such factors, the females, one. The location of the female-determining factor is less certain. It appears to be inherited purely maternally. Goldschmidt believes it to be contained in the Y-chromosome, which in moths, where females are heterogametic, is confined to females; and to act on the cytoplasm of the egg before fertilization. Be that as it may, it appears to be definitely proved that it is inherited in the female line only, and that the amount of this factor present is the same in males and females.

In males there is thus a double dose of male-determining factor—call it *M*—to a single dose of female-determining factor, *F;* further, 2 *M* is more effective than *F*. Translated into ordinary terms, this would imply that the factors *M* and *F* are normally responsible for the continuous production of two substances, say *U* and *O,* which are responsible for the development of maleness and femaleness respectively, and that the total of *U* produced by 2 *M* is so much in excess of the amount of *O* produced by *F* that normal males are the result. Conversely in normal females, there is a single dose both of *M* and *F;* and further *F* is greater in its effect than *M;* and so *O* is produced in excess, and can exert its effects and give rise to females.

The commonest type of intersex, that which starts as female and ends as male, is an individual in which a slow-working *F* is combined with a fast-working *M* factor. This implies that the curve of *O*-production is depressed, that of *U*-production raised; this in its turn will mean *an intersection of these curves* during or before the formative period when differentiation is occurring, so that an original excess of *O* is succeeded by a later excess of *U* and the animal changes from female to male. The converse change from original male to the later female development scarcely ever occurs unless *two* slow-working *M's* are associated with a fast-working *F,* and

LARVAL FORM OF WHITE AXOLOTL

FIGURE 8. The axolotl is found in Mexico, where it has been used as an article of food for centuries. The "white" axolotls are a pale flesh color, with beautiful red gills. Normally axolotls do not metamorphose, but retain their larval form throughout life. Iodine or thyroid treatment produces metamorphosis, and this brings up the interesting question of why this change does not normally occur, as the axolotls have functional thyroids which produce metamorphosis when grafted into anuran larvae.

this will only happen in the second generation from a cross.

There would seem to be no reasonable doubt, after Goldsmith's work, that some such quantitative change in the "potency" of male and female-determining factors does occur, and that this change in potency implies a quantitative change in the amount of some substance produced during the course of development, which in its turn affects the development of sexual characters.

As to the precise way in which these sex-determining substances act, however, we are very much in the dark. In any event, we shall not be far wrong if we try to think in terms of metabolism. There is, at least, no doubt that the males and females of insects, (as well as of other organisms), possess different types of metabolism. The evidence for this is reviewed in Goldschmidt's book.[9] We may conceive of this in two main ways. Either the sex-determining substances are markedly specific in their action on sexual characters, i. e., act locally on particular organs, as does the hormone *secretin* upon the pancreas; this would appear to be the case with the sex-hormones of mammals and birds.[17, 18] The sexual differences in metabolism would then be secondary results of the different development of the gonads. Or else these substances act primarily upon metabolism, turning on one of two alternative switches, so to speak, which lead to two different types of metabolism, which result in different internal environments. In one environment one chain of relations would occur and would lead to male development. The primary effect of the sex-factor might concern some general fundamental function, such as oxidation, and not be specific or local in its action on sexual characters at all; in this case the primary effect would be on general metabolism, which would lead, as a secondary result, to sex-divergence. There remains a third

possibility—that the two apparent alternatives are as a matter of fact combined—that from the outset the excess of one of the sex-determining substances causes a change in metabolism, but that it also produces a specific substance promoting localized growth in one or the other set of sexual characters.

In higher animals, with gonads producing an endocrine secretion, the probability is that the first alternative is true, or quite possibly the third. For animals without a gondial hormone, however, as insects have been shown to be, the probability is that the second alternative, or again possibly some form of the third, is true.

We should remember that in various low forms, e. g., the oyster,[19] seasonal and age differences are associated with change of sex, that in other organisms, e. g., Hydra and certain plants, sex appears to be wholly or partially determined by external conditions. We can compare regulation of sex by environment, whether internal or external, to the regulation of dimorphism by environment, which occurs in certain plants. In *Polygonum amphibum,* for instance, and in *Ranunculus aquatilis,* it is well known that the plant may occur in two main forms, the aquatic and the terrestial. The assumption of one or the other of these forms is, however, not determined genetically, but by the environment of the plant. Its genetic constitution is so constructed that when the plant grows in water it will embark on a series of reactions leading to the water form, and *vice versa,* when it is on land. Here the influence on general metabolism is primary, the specific form-difference is determined secondarily as a result of the primary influence.

Finally in the Diptera, the group of insects to which the flies belong, we have fairly definite proof that the germinal factors responsible for sex-determination, or at least some of them, are of a nature which can hardly be supposed to exert specific effects upon the development of sex-characters, but can readily be supposed to act on general metabolism. In a very remarkable recent paper Bridges summarizes his work upon triploid stocks of Drosophila.[5] It is impossible to go into the evidence he presents, but a few points important to our general argument must be mentioned. In the first place, he shows conclusively that sex-determination in Drosophila is not, as was at one time held, a question of the *absolute amount* of some factor contained in the X-chromosome, so that two doses of X invariably produce females, one dose invariably males. Rather it is a matter of a relation between the amount of some factor carried in the X-chromosome and of some other factor or factors carried in the rest of the chromosomes.

His triploid stock usually carries three instead of the normal two sets of autosomes, together with either one, two, or three X-chromosomes. Let us call a single set of autosomes *A*. Then it was found that a chromosome formula 3X:3A gave normal femaleness, just as does 2X:2A in normal diploid stock. 1X:2A in diploid stocks gives normal maleness. 1X:3A in triploid stocks gives sterile "super-males"; while 2X:3A—an intermediate ratio—gives intersexual individuals combining male and female characters; 3X:2A individuals, discovered in other experiments, were sterile "super-females." Thus we have a state of affairs perfectly consonant with Goldschmidt's ideas. However, Bridges was able to push the matter still further in one direction. Owing to the fact that the small fourth chromosome, though sometimes present in triplicate like the rest of the autosomes, was at other times only present in duplicate, he was able to show that there was not a *single* male-determining factor, but at least two (probably many)—one (or one set) lodged in the fourth chromosome, the rest in the other autosomes. The set in the fourth chromosome appears to exert a disproportionately strong effect. Ob-

PARTLY METAMORPHOSED

FIGURE 9. Iodine treatment is having its effect most markedly in the reduced size of the gills. The dorsal fin is also smaller, but there is little change in the size or shape of the head. Metamorphosis appears to be caused by a change in the internal environment, resulting in a higher rate of metabolism. This is favorable to specifically adult tissues, but larval organs and tissues cannot "keep the pace" and break down. The specimen shown here is a black axolotl, while the one shown in Figure 8 is white.

viously the simplest way to envisage the problem here presented to us is to suppose, first, that a complete set of chromosomes is necessary for development; second, that a definite quantitative preponderance of certain factors contained in the autosomes results in a type of metabolism leading to an internal environment in which male characters are expressed; and third, that a preponderance of certain factors contained in the X-chromosome produces another type of internal environment in which female characters can develop.

It further follows that, in such a case, it is not necessary to postulate the existence of specific sex-determining factors at all, but merely of factors which influence metabolism in a way favorable to the expression of male or female characters, respectively. The difference between this and the state of affairs in plants like *Polygonum amphibium* is that in our cases the genetically-determined sex-chromosome mechanism normally provides the two proper quantitative relations of the two sets of factors, whereas in Polygonum there is no genetic basis for the regulation of the dimorphism. Haldane[11] has recently expressed the view not only that the assumption of specific sex-factors is unnecessary, but that it should not be made until the more economical alternative has been tested. Such an idea is borne out by the recent remarkable work of Blakeslee and his co-workers, on the effect produced by the presence of abnormal numbers of certain chromosomes in Datura.[4]

In any event, what is important for our present purpose is definitely established: (1) that the dimorphism of sex is brought about in higher animals by a zygotic difference in the *relative amount* of certain factors in

the germ-plasm, in other words is determined as the result of a certain *quantitative balance* between these genes; (2) that the *rate of working* of these factors is important, since their effect is ultimately exerted through their chemical activity; (3) that by making, through racial or species crosses, certain combinations of these factors, it is possible to produce a *consecutive intersexuality—i. e.,* sex-dimorphism in time in one and the same individual, one sex phase giving place to the other after a certain moment. This effect is due to combining relatively slow-working factors for one sex with relatively quick-working factors for the other, and to the consequent intersection of the curve of production of their sex-determining substance or substances.

Having established these points, we may profitably consider the last a little further. In the first place it should be noted that various animals besides the Gipsy Moth may show a similar sex-reversal during development; but in animals in which no hard parts connected with sex are laid down in permanent and unalterable form, the transformation from one sex to the other will almost always be eventually complete, since the soft parts of one sex will be absorbed or remodeled and those of the other sex laid down in their place. This, as a matter of fact, occurs in Frogs, as Witschi,[24] Crew[6] and others have shown. To get evidence of the sex-change here we must either argue indirectly from sex-ratio, or follow the individual during its development.

In the second place, there are a great many forms of life in which a consecutive sex-dimorphism—in other words, sex-reversal at a certain point of time during development normally does occur. There are the numerous bisexual forms that rise by male or female individuals taking on the characters of the other sex, and giving rise to protandric and protogynous hermaphrodites, the former kind being the more abundant. This question has been treated at length by Goldschmidt in the work previously cited[9]. Suffice it to say that frequently the change of sex appears definitely to be associated with and determined by a change in metabolism, such as that inevitably brought about by increase of size and age. Here one might speak of normal and abnormal sex-metamorphosis, normal in hermaphrodites, abnormal in Goldschmidt's moths and Crew's frogs.

This brings us back to the question with which we started—a question which this, I fear somewhat lengthy digression, has been intended to illuminate. In these cases which have been properly analysed, sex-metamorphosis has been shown to depend on the intersection of the curves of production of certain substances. The production of these, in their turn, depends upon the relative amounts or rates of working of certain factors in the organism's constitution. Why, we may then ask, if it is possible to have such sex-metamorphosis, should not a similar state of affairs be supposed to exist in true metamorphosis? I will endeavor to show that such a state of affairs may very probably be supposed to exist.

We have first to suppose—what is clearly the case—that the germinal constitution of the Anura (which I choose because the problem has in them been most intensively studied) is such that it interacts with the normal environment to produce the tadpole type of organization, and *this whether a thyroid be present or not.* The experiments of Allen[2] and others with thyroidectomized tadpoles show conclusively not only that normal healthy growth is possible in tadpoles without a thyroid, but that the tadpole organization will persist and grow to a size far above normal when no thyroid is present. Some of Allen's thyroidless tadpoles grew to a length of several inches and became almost as large as the normal metamorphosed adults of the species. It is quite clear, then, that the tadpole type of organization

METAMORPHOSIS COMPLETE

FIGURE 10. The dorsal fin and external gills have disappeared, the shape of the head has changed and the eyes protrude. There is also a marked loss of flesh. The thyroid is not specifically a metamorphosis-producing agent, and its effects are probably confined to speeding up metabolism. The time of metamorphosis in different species is determined by the ability of the larval tissues to hold together under the intensified metabolic processes set up by greater concentration of thyroid.

can exist independently of age or size *when no thyroid is present* and that therefore age or size *per se* has no influence upon metamorphosis.

The normal tadpole, however, at an age when only the rudiments of limbs are present, possesses a well-developed thyroid. Swingle,[21] working with neotenous bull-frog tadpoles, *i. e.*, individuals in which the metamorphosis is abnormally delayed for one or more years, found that their thyroids were perfectly capable of inducing metamorphosis when grafted into tadpoles of small species. Further he tried the same experiment with the thyroid of the normally neotenous Axolotl and found that it, too, could cause precocious metamorphosis in frog larvae.

Perhaps most remarkable of all is the fact that in permanently neotenous forms, such as Necturus, Hogben and Swingle have independently shown that no amount of thyroid feeding,[14] nor thyroid feeding and grafting, together with pituitary treatment,[21] will bring about metamorphosis. The utmost that has been observed with any perennibranchiate form, as a result of thyroid treatment, is a slight reduction in height of the fin. On the other hand, Swingle has shown that the thyroid of Necturus will produce metamorphosis when grafted on Anuran larvae. It has further been found impossible to produce metamorphosis in Lampreys by thyroid treatment of the Ammocoete larvae.[15]

The first thing that is clear is that the thyroid is not a specific "metamorphosis-producing" agent. In some metamorphosing animals it does, in others it does not produce metamorphosis. Furthermore, recent work of Hogben shows that injection of anterior lobe of the pituitary causes metamorphosis in thyroidless as well as in normal Axolotls, so that the effect of the pituitary upon metamorphosis

may be direct and not, as was previously supposed, exerted solely indirectly by stimulating the thyroid.[13]

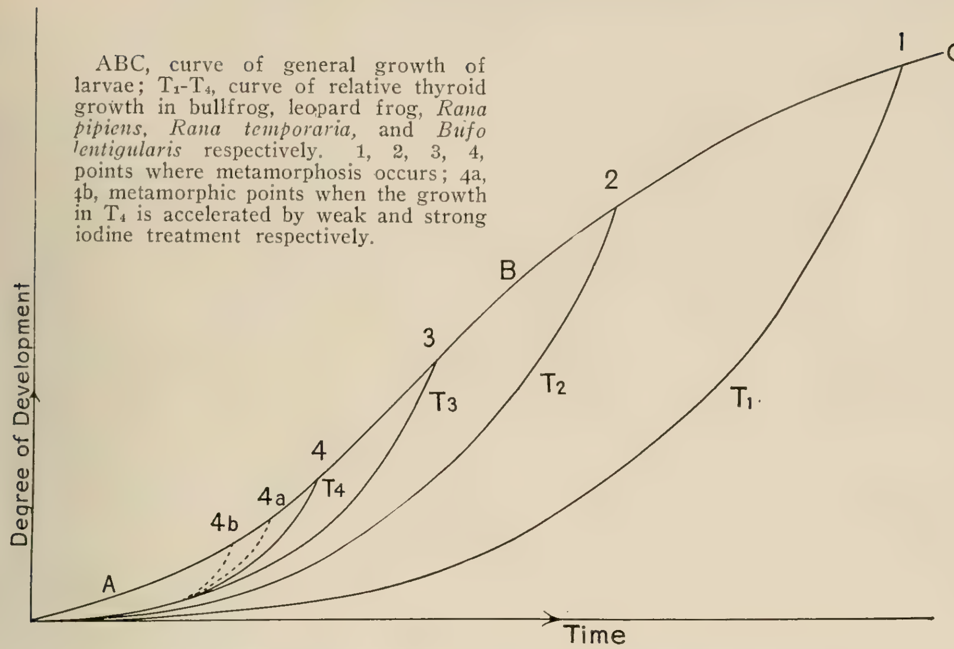
The fact that not only are limbs fully formed before metamorphosis in Urodeles, but that they do not appear to be affected in their growth by iodine treatment,[23] whereas they may be formed quite precociously as the result of that treatment in Anura, shows that the same organ responds in a totally different way in the two groups. The resorption of the tail in Anura, and its non-resorption in Urodela, is a fact of the same order. Our next assumption, therefore, is that metamorphosis is not, in the main, a specific effect of thyroid secretion in the sense that thyroid secretion has a special growth-promoting effect on certain types of organs, but that it is what we have called a general effect upon metabolism, inducing a different internal environment. The larval organization is adapted to one environment, the adult to the other; as the first environment changes into the second, the larval organs can no longer maintain themselves, and break down, just as do the female structures, such as ovary and oviduct, in a female frog which is becoming transformed into a male, in which, therefore, the internal environment favors the growth of male and discourages that of female characters.

It is further clear that, if this be so, we need no longer go to the trouble of postulating a change of function in the thyroid, for we can think of the change as occuring *when a certain relative concentration of thyroid secretion* exists in the organism. In other words, metamorphosis, like sex, is an affair of balance. It is not the absolute amount of thyroid secretion which is at the root of the matter, but the amount of thyroid secretion considered in relation to the amount of certain other substances, or the intensity of other processes. There is therefore a normal threshold value for the amount of thyroid secretion necessary to produce metamorphosis in a given species, but this need not be the same, even when calculated relative to body weight, for different species; and it may be possible to alter this value artificially in any one species. It need not be the same, for it will be exerting its effects *relatively* to other metabolic processes, and these may be different in different species.*

That the thyroid exerts its effects by a special effect on cell metabolism is made probable by the important discovery of Hogben, that injections of anterior lobe of the pituitary will produce metamorphosis even in thyroidless Axolotls.[13] That pituitary as well as thyroid is concerned with increasing basal metabolism, is rendered highly probable by the work of Hill[12] and Benedict and Homans[3].

Let us consider a few facts in the light of these considerations. Uhlenhuth, in a very interesting paper,[22] has shown that in certain Urodeles, which in this regard are probably similar to Anura, metamorphosis is corelated not with growth-rate, but with the attainment of a certain size. At a given temperature this size will be constant, whether the animal is well fed and grows rapidly, or half starved and grows very slowly. We may take this to mean that differentiation and growth of thyroid and of the rest of the body are, as one would expect, bound up together, one affecting the other. He also finds that the "metamorphic size" changes with the temperature; at low temperatures the size is greater (by about 10% in body length). This would imply that the temperature-coefficients for thyroid and general body differentiation are slightly different. It is worth noting that Goldschmidt has found similar temperature effects in his intersexual

* This threshold value refers to the concentration just prior to and at the time of metamorphosis. There is some evidence to show that in adult Anura, the concentration of thyroid hormone decreases again; but, since metamorphosis is irreversible, no morphogenetic processes ensue.



FACTORS DETERMINING TIME OF METAMORPHOSIS

FIGURE 11. Metamorphosis may be conceived of as being brought about by differential growth of the thyroid and the body tissues. At first the body tissues develop faster than the thyroid, but later on their rate of development slows down while that of the thyroid increases. Inevitably, then, the curve for body growth and the curve for thyroid growth will cross, and at this point metamorphosis occurs. Metamorphosis, like sex in Goldschmidt's moths, is an affair of balance, but the changes are irreversible and a decrease in thyroid concentration after metamorphosis has taken place does not result in a return to the larva state, or "katamorphosis" as it might be called.

moths; alteration of temperature causes alteration of degree of intersexuality,—in other words, alteration of the stage of differentiation at which the "sex-metamorphosis" occurs.

This matter of differential temperature-coefficient is obviously of importance. What complex effects it may produce in what at first sight appears a simple phenomenon is shown by such work as that of Fenn on phagocytosis.[7]

It is worth noting that this differential temperature-coefficient possibly exerts an indirect effect upon sex in Amphibia. Witschi found that temperature changes brought about alterations in sex-ratio in frogs;[24] and Adler found that in late-fertilized frogs (which, as is well known after the researches of R. Hertwig's pupil, Kuschakewitsch, all become males[16]), the thyroid was abnormally large[1]. This, together with the previous connection between temperature and relative rate of thyroid-differentiation, as shown by alterations of metamorphic size, makes it at least possible that the sex effect of temperature in frogs is connected with an effect upon the thyroid. A good example of the *relative* nature of the thyroid's action is afforded by the fact that the time required for metamorphosis by thyroid feeding in sexually mature Axolotls is longer than in immature specimens[14]. This is also true for pituitary metamorphosis[13]. Apparently the change of metabolism due to maturity, and increased size and age raises what we may metaphorically call the resistance of the larval tissues to metamorphosis.

The reason that the thyroid of frog larvae belonging to large species which do not metamorphose their first year may yet be active when grafted into larvae of other species need not, then, mean that the grafting has in some way altered their function, or that an "excretor substance" is present in the grafted larvae which stimulates the grafts to secrete outwards instead of to store their secretions. It merely indicates that the amount of thyroid secretion in larvae of the slow-metamorphosing species remains relatively too low for a longer time than in the others. It is important to notice that this relative slowness in the amount of thyroid secretion may be brought about in two opposite ways—first by decreasing the relative rate of differentiation of the thyroid, or secondly by altering the activity of those other processes in the body against which the thyroid acts.

Whenever a phenomenon is the result of two opposing tendencies, this double possibility of altering the result will of course be present. For instance, it is well known that the resorption of a malignant tumor may be due to damage inflicted on the tumor or to raising the resistance or general activity of the rest of the organism. In a similar way recent physiology emphasizes the existence of a similar balanced action in certain neuroses.[20]

If we look at our facts in the light of our analogy from sex, we may say that metamorphosis is comparable to consecutive hermaphroditism, and is thus a normal process similar to the abnormal process causing intersexuality in the Gypsy Moth. It is consecutive dimorphism; and is due to the fact that the hereditary constitution of most Amphibia is so constructed that a thyroid is produced only after a certain stage, that it then differentiates relatively more rapidly than the rest of the organism, and that the relative amount of thyroid secretion therefore gradually increases until it reaches the threshold value necessary to bring about metamorphosis. (Fig. 11.)

(To be continued.)

Literature Cited

1 Adler. *Arch. Entw. Mech,* xliii:343. 1917.
2 Allen, B. M. *Jour. Exp. Zool.,* xxiv:499. 1918.
3 Benedict and Homans. *Jour. Medical Research,* xxv:409. 1912.
4 Blakeslee, A. F. *Amer. Naturalist,* lv:253. 1921.
5 Bridges, C. B. *Science,* liv:252. 1921.
6 Crew, F. A. E. *Journal of Genetics,* xi:141. 1921.
7 Fenn, W. O. *Jour. General Physiol,* iv:331. 1921.
8 Goldschmidt, R. *Zts. Ind. Abst. Vererb,* xxiii:1. 1920.
9 Goldschmidt, R. *Mechanismus und Physiol. des Geschlechtsbestimmung.* Berlin, 1920.
10 Gudernatsch. *Arch Ent. Mech,* xxxv:457. 1912.
11 Haldine. *Journal of Genetics.* 1922.
12 Hill. *Quarter. Jour. Medicine,* xv. 1922.
13 Hogben. *Proc. Zool. Soc.* 1922.
14 Huxley, J. S., and Hogben. *Proc. Royal Soc. (B),* xciii:36. 1922.
15 Jensen, C. O. *Mddel. Kgl. Vet. Landb.* Copenhagen. xliv. 1916.
16 Kuschakewitsch. *Festsch* fuer R. Hertwig. 1910.
17 Lillie, F. R. *Journal Exp. Zool.,* xxxiii. 1920.
18 Minoura, T. *Jour. Exp. Zool.,* xxxiii. 1920.
19 Orton. *Nature.* cvii:586. 1921.
20 Rivers, W. H. *Instinct and the Unconscious,* p. 199. 2nd Ed. Cambridge University Press.
21 Swingle, W. W. *Anat. Rec.,* xxiii. Pp. 31, 100, 106. 1922.
22 Uhlenhuth, E. *Jour. Gen. Physiol.* i:473. 1919.
23 Uhlenhuth, E. *Biol. Bull.,* xlii:143. 1922.
24 Witschi. *Zt. Ind. Abst Vererb.,* xxix:31. 1922.

HERITABLE CHARACTERS OF MAIZE

XII—MEALY ENDOSPERM[1]

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MEALY endosperm is a type of defective seed in which the corneous or "horny" portion of the endosperm is partially or completely lacking. This causes the seeds to be smaller, lighter in color, and soft and mealy in texture. When the corneous endosperm is completely aborted the mature seeds are so soft that they may be easily split apart with the finger nail. The embryo is apparently normal in structure, though somewhat reduced in size. The starch grains when examined under the microscope appear to be normal in size and structure. Because of the greater proportion of starch in the seeds, and the fact that the pericarp attains almost complete development regardless of the size of the endosperm, the mealy seeds have a characteristic dull and shrivelled appearance not readily confused with the character *shrunken endosperm* described by Hutchinson.[2]

Mealy seeds were first observed by Dr. D. F. Jones on a segregating self-pollinated flint ear grown by Dr. E. G. Anderson at Cornell. On account of their resemblance to the partial defectives described by the former in the Journal of Heredity,[3] Dr. Anderson very kindly furnished him with seed from this ear. This was grown in the summer of 1920 and crossed with several other types of defectives. The F_2 generation, grown in 1921, was turned over to the writer for classification and further investigation, together with the data previously obtained by Dr. Jones.

Separating and counting of the kernels from nine selfed ears show this character to be a simple Mendelian recessive. Table I shows the tabulated results from these nine ears.

TABLE I.

Ear No.	Normal	Mealy
277	149	46
277—1	190	58
277—2	149	46
277—1—1	256	65
277—1—2	209	59
277—1—3	134	43
277—1—4	166	52
277—1—5	187	78
277—1—6	168	54
Total	1608	501
Expected 3:1	1582	527
Deviation	+26	—26

It was impossible to cross this character directly with other defectives on account of the difficulty of obtaining any of these types in a homozygous condition. However, when a number of segregating plants were crossed, all of the F_1 seeds were normal. If the two types of defectives are genetically distinct we would expect to get in the second generation four kinds of ears, as follows:

1. Ears not segregating.
2. Ears segregating partial defectives.
3. Ears segregating mealy defectives.
4. Ears segregating both types.

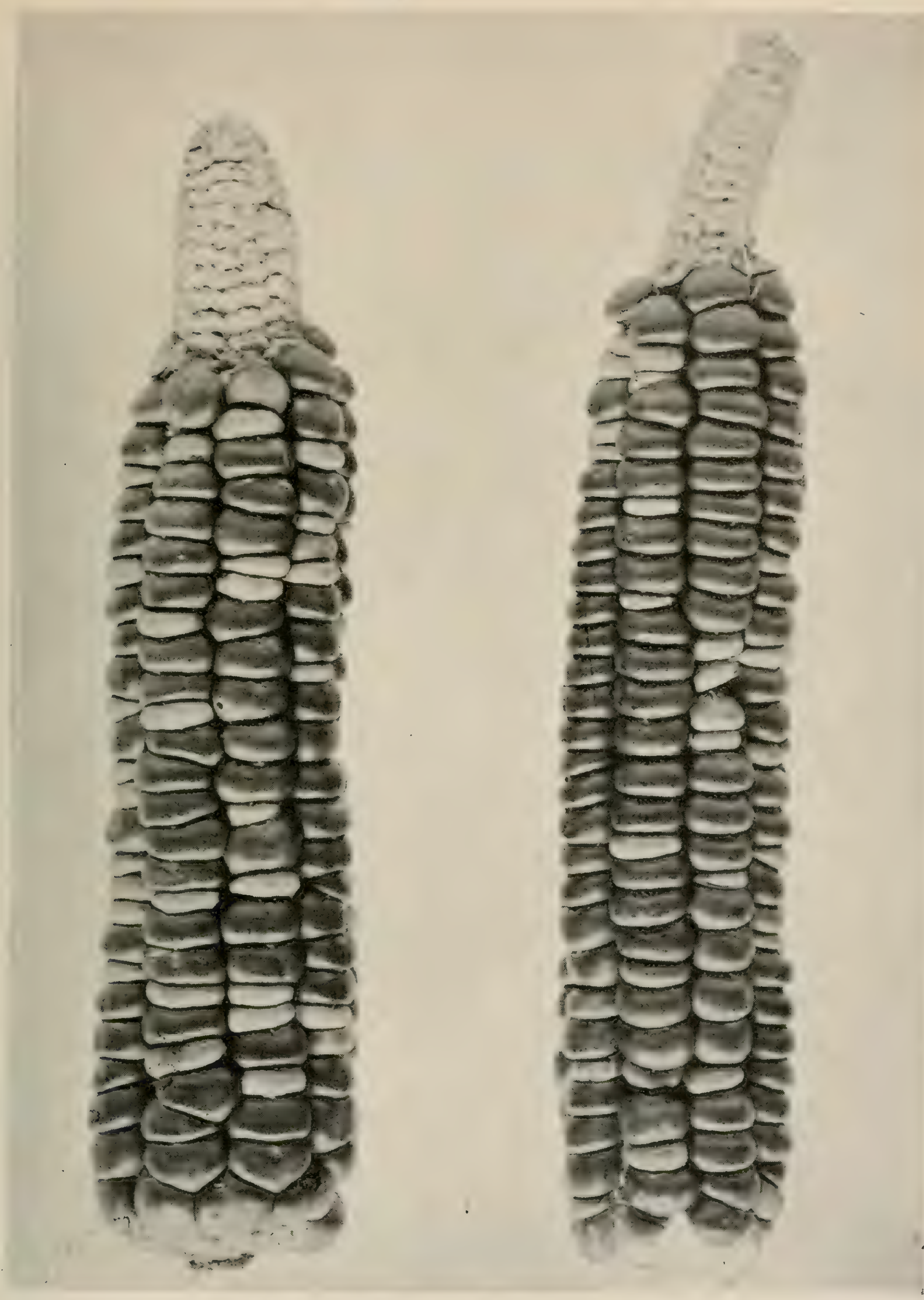
[1] contribution from Bussey Institution, Harvard University.

[2] Hutchison, C. B. Heritable Characters of Maize—Shrunken Endosperm. *Journal of Heredity*, xii:76:83.

[3] Jones, D. F. Heritable Characters of Maize—Defective Seeds. *Journal of Heredity*, xi:160-167.

A LETHAL FACTOR IN MAIZE

FIGURE 12. Mealy endosperm acts as a lethal factor because the seedlings from mealy seeds (right) are very small and weak as compared to the normal, and seldom survive.

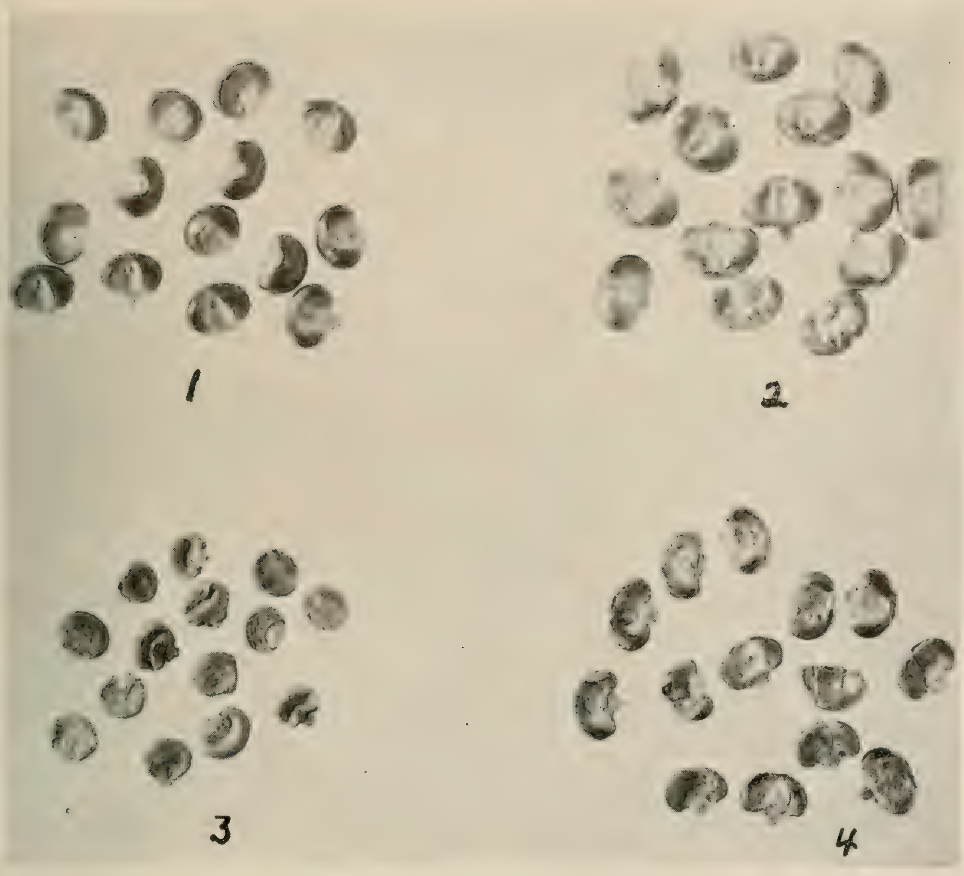


MEALY ENDOSPERM "ON THE COB"

FIGURE 13. The mealy seeds are somewhat smaller and lighter in color than the normal seeds on the same ear. Because of the phenomenon of double fertilization in maize, the endosperm as well as the embryo is of hybrid origin, one fertilized egg nucleus producing the embryo, and two others the endosperm. Therefore the results of crosses made to study inherited defects in the endosperm can be read directly from the ear without the necessity of raising a second generation.

LINKAGE WITH CHLOROPHYLL DEFICIENCY

FIGURE 14. The seedlings at the right were grown from mealy seeds and those at the left from normal seeds on the same ear, which was also heterozygous for white seedlings. Nearly all of the normal grains produced green plants, and a large part of the seedlings from mealy grains were white. The exceptions indicate that the condition represents a case of true linkage, and not distinct expressions of the same germinal factor. If the two characters were genetically identical and owed their existence to the same factor, we would not expect them ever to be separated.



NORMAL AND DEFECTIVE SEEDS

FIGURE 15. The mealy seeds (3) resemble very closely another type of defective seeds (4), but the two are entirely distinct genetically. Normal seeds are shown at (1) and (2).

Table II shows that all four kinds of ears were obtained and indicates clearly that the two defectives, although resembling each other rather closely, are genetically distinct.

TABLE II.

Ear No.	Normal	Partial defectives
1	208	71
6	248	86
11	111	37
Total	567	194
Expected 3:1	571	190
Deviation	—4	+4

Ear No.	Normal	Mealy defectives
3	212	85
4	212	86
7	237	49
Total	661	220
Expected 3:1	660	221
Deviation	+1	—1

Ear No.	Normal	Both types
2	187	108
5	169	117
8	169	105
Total	525	330
Expected 9:6	513	342
Deviation	+12	—12

Ears 9 and 10 not segregating.

On account of the phenomenon of double fertilization in maize, the F_2 endosperm develops on an F_1 ear.[4] The F_1 plants are, as a rule, extremely vigorous and the mealy seeds when borne on a hybrid plant are appreciably altered in appearance. There is a partial development of the corneous endosperm and the seeds are often almost normal in size. The white portion of the endosperm showing through the incomplete corneous layer gives the seed a dull and mottled appearance. Seeds of this description are often found on ears not carrying the factor for mealy, especially when the ear has ripened prematurely. Separation of mealy seeds after crossing is consequently more difficult and less accurate.

It appears that the genetic factor for mealy does not specifically inhibit the formation of corneous endosperm. It simply arrests the development of the growing seed at a certain stage. The horny layer which is apparently formed later in the process is thereby ordinarily eliminated. On the hybrid plant, however, where the various stages follow each other in more rapid succession, the corneous endosperm has an opportunity to become partially developed before the factor for mealy can operate. Just how this character would manifest itself in floury types of corn in which the hard endosperm is completely lacking is not known, but it would presumably result merely in a loss of size.

A Lethal Factor

Practically speaking, mealy is a lethal factor because under ordinary field conditions the mealy seeds will not grow. When planted in the greenhouse under optimum conditions of temperature and moisture the recessive seeds show a germination of twenty per cent. The seedlings are very small and weak, as shown in the illustration, and survive but a short time. Seeds from F_1 ears have a higher germination and produce more vigorous plants, but even these ordinarily live only a few weeks.

Linkage Relations

The linkage relations of this character were discovered quite by accident. In one of the F_1 ears the mealy seeds were so well developed that it seemed feasible to plant a row of them in the field in order to get the character in a homozygous condition. A week later when the seedlings had emerged this row was easily the most conspicuous feature of the entire field. All of the plants were albinoes except one. This solid row of white seedlings in sharp contrast to the rows of green ones on either side made a very striking demonstration of linkage.

The other ears of this cross were later tested for linkage and the data are given in Table III. Figures for only those ears segregating both mealy and white seedlings are given. Since only part of the seeds were planted and since the germination was never perfect, no attempt has been made to reduce the figures to actual linkage values and only the percentage of each type are here given. This provides but an indication of the linkage values, but in cases where it is impossible to back-cross the hybrid with the double recessive, one cannot arrive at more than a rough approximation.

TABLE III.

Ear No.	Normal		Mealy	
	Green	White	Green	White
2	126	15	30	20
4	158	19	23	19
5	79	19	0	19
7	130	20	1	39
8	119	1	28	32
Total.	612	74	82	129
Percentage	89.2	10.8	38.9	61.1

[4] WEBER, H. J. Xenia, or the immediate effect of Pollen in Maize. *Bulletin 22*, Division of Vegetable Physiology and Pathology, U. S. Department of Agriculture. 1900.

Of the normal seeds planted only 10.8 per cent. produced white seedlings, while 61.1 per cent., or almost six times as many, of the mealy seeds developed into albinoes. If the characters were inherited independently approximately 25 per cent. of both types of seed should produce white seedlings. Clearly there is some definite relation between mealy endosperm and this type of chlorophyll deficiency. There is a possibility that the relation may be physiological rather than a case of true linkage; that both abnormalities are merely the expression of the same physiological condition. The fact that normal ears of this strain often segregate for white seedlings and that mealy seeds sometimes produce only green plants seems, however, to preclude this possibility. Further tests are now being made to determine more definitely the relation that exists between these two lethals.

The Freudian Obsession

Mysticism, Freudianism and Scientific Psychology, by Knight Dunlap. C. V. Mosby Co., St. Louis, Mo.

Prof. Dunlap in this condensed volume fights the battle of common sense as well as that of scientific psychology. He does it simply and effectively. The book shows thorough acquaintance with modern psychology in its writer, but does not necessarily demand such acquaintance in its readers. The book has three sections. The first of these discusses the varied phenomena of religious mysticism, especially where such mysticism passes over into the extremes that become more or less completely hysterical. The second considers even more at length these same hysterical exaggerations in their grosser manifestations of extreme Freudianism, psychoanalysis, christian science, etc. The third section of the book develops succinctly and clearly both the methods and the results of true scientific psychology in its study of mental phenomena as contrasted with the methods of these scientific heresies. We wonder whether it was necessary to include so many of the excessive and offensive exaggerations of Freudianism as are here quoted. A very few such samples would seem sufficient to develop all the distrust and the disgust which was necessary. However, if revelation of the erotic hysteria of such pseudoscience were needed, it is here abundantly provided.—*R. E. C.*

Books Received

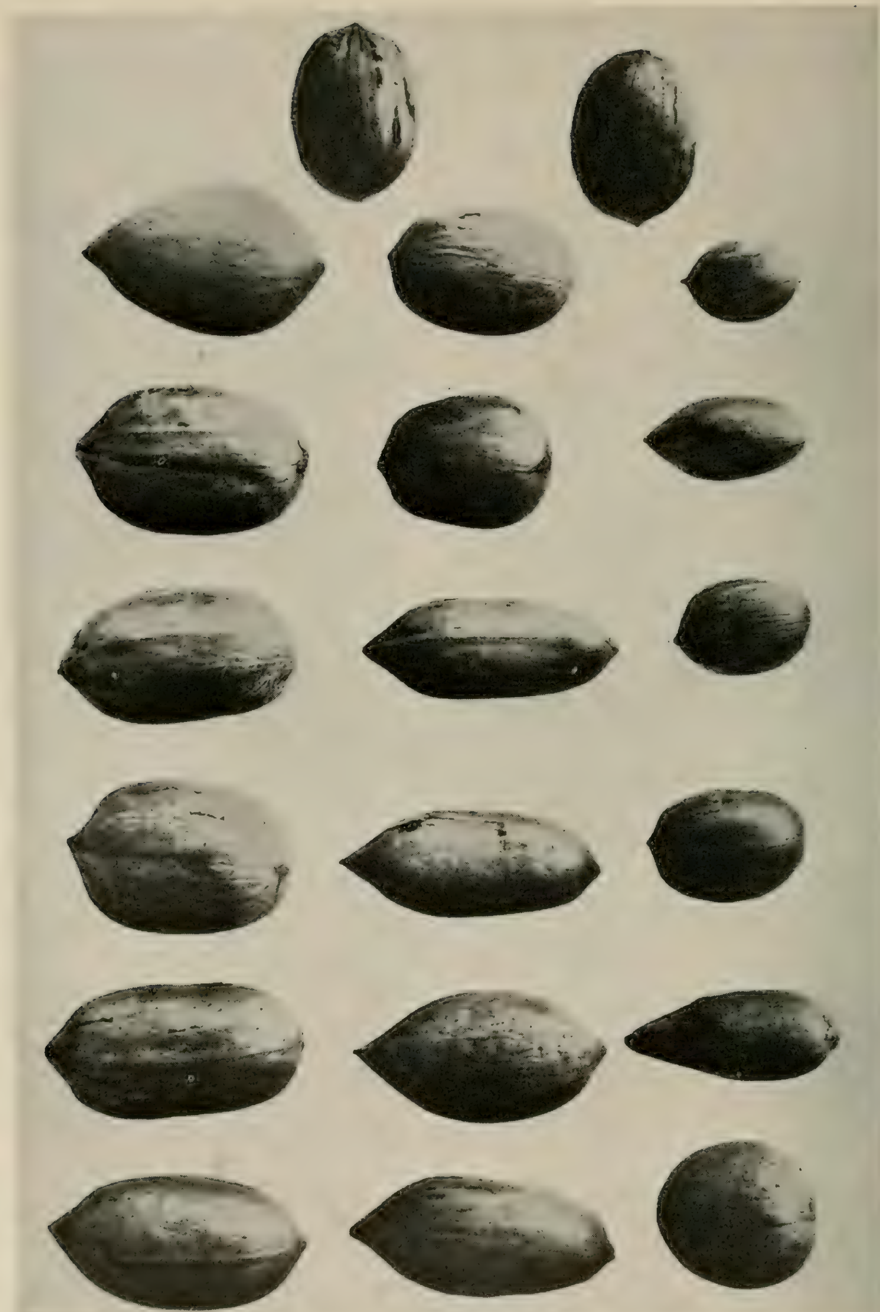
The Biology of Death, by Raymond Pearl. J. B. Lippincott Company, New York. 1922.

Human Life as the Biologist Sees It, by Vernon Kellogg. Henry Holt and Company, New York. 1922.

The Physiology of Twinning, by Horatio Hackett Newman. The University of Chicago Press, Chicago. 1922.

Social Change, by Henry Fielding Ogburn. B. W. Huebsch Co., New York. 1922.

Glands In Health and Disease, by Benjamin Harrow. The Macmillan Co., New York. 1922.



PECAN SIBLINGS

FIGURE 16. The two nuts at the top of the picture are from the parent tree, the original San Saba. The others are from eighteen seedling trees raised from a single season's crop of the mother tree. Each represents the type of the nuts of the tree from which it was taken, as all nuts from a single pecan tree are remarkably alike. Only four of the seedlings were considered of sufficient value to propagate and two were introduced as named varieties.

VARIATIONS IN PECANS

F. W. Brison

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FEW plants show such a wide variability as the pecan when it is reproduced from seed. This is so great as effectually to prevent the propagation of improved varieties by seed, though it offers the pecan grower a good opportunity for the introduction of new varieties by selection. New varieties obtained can be perpetuated indefinitely by budding and grafting. From the breeder's point of view this great diversity of the sexual progeny of pecan trees is very fortunate, as it is only through the occurrence of variations in any plant that further improvement within that species is possible.

The Pecan Crop

Every section of the country has a crop or enterprise of which it is proud. The time is probably not very remote when the South will boast as loudly of her pecan industry as she does now of her cotton, and pecans will be as widely advertised as the walnuts of California. The pecan is indigenous only to certain parts of the southern United States and a small section of northern Mexico. Dean Kyle, of the Texas A. and M. College, declares that Texas is the real home of the pecan; and Texas alone has more native pecans than all the other states combined.

In 1919, 16,755,421 pounds of pecans valued at $3,698,233 were produced in Texas. Probably nowhere else in the world does nature, unaided by man, produce a crop, ready for the market, of as great a money value. Within the last twenty years large areas have been planted to improved varieties of pecans in Georgia, Alabama, Mississippi, Florida, and Louisiana; and these states are now leading in the production of improved varieties.

The pecan is monoecious, the staminate flowers or catkins being borne on wood of the preceding season's growth, while the pistillate flowers are borne on wood of the current season's growth. The pollen grains are carried from the catkins to the pistils by wind primarily, and by gravity. Naturally, then, a high percentage of cross pollination will take place. It is believed that under the most favorable climatic conditions, viable pollen grains may be carried a distance of three or four miles. The pecans produced by one tree are the result of the union of the sperm cells of pollen grains from many different trees with the egg cells of the mother tree. Consequently the result of each fertilization is apt to vary in one or more respects from the result of all other fertilizations, owing partially to the difference in the paternal influence as well as to the difference due to segregation of characters in the production of the egg cells by the mother tree. The shell of a pecan is purely maternal tissue, and so similar are all the nuts produced by a variety that trees, the variety name of which is not known, can be identified by the nuts they bear.

Production of New Varieties

Self- or close-pollination of pecans for seed purposes is frequently recommended. It is no doubt a good practice but it does not insure an exact reproduction of the pecans planted because of the heterozygous character of the pecan; it only increases the chances of getting a good tree from the seed planted. The pecan tree is slow in coming into bearing, requiring from five to twelve years from the time a nut is planted until the tree produced from it bears seed. Any attempt to produce

a pure line by self-pollination will necessarily have to be extended over a very long series of years. Most of the so-called "improved" varieties of pecans were originally found growing wild and have been propagated asexually ever since.

On exhibit at the Horticultural Show of the A. and M. College of Texas in 1922, was a display of thirty-six distinct types of pecans, produced by thirty-six different trees that were grown from seed, all produced the same year by a single mother pecan tree, the original San Saba. Of the thirty-six samples only four are considered as good as, or better than the mother tree. Two of them, the Texas Prolific and Western Schley, have been introduced as named varieties. In size of nuts there is a rather uniform gradation from those as large as beans to those over two inches in length. No correlation between size of nut and thickness of shell is evident. Some of the larger nuts have very thin shells, while some of the smaller ones have extremely thick ones, and *vice versa.* The accompanying picture gives only a inadequate idea of the difference between these varieties, since size and shape are the only qualities which show up well in pictures. There are also marked differences in flavor, proportion of kernel to shell, readiness with which kernel separates from shell, and habits of growth of the tree from which the nuts came.

The man who planted the pecans and expected the progeny to be exact reproductions of the San Saba variety convinced himself by this demonstration that propagation of pecans by seed is not a reliable method; and he is now perpetuating his standard varieties by budding and grafting. He continues to plant pecan seeds only in the hope of obtaining chance seedlings which will be good enough to introduce to the public as named varieties.

Thus it will be seen that the propagation and improvement of the pecan is governed by the very same principles which govern the apple, pear, and other fruit and nut trees. There is this one difference, however: the development of the pecan is so recent that there still remain greater opportunities of finding superior seedlings than is the case with the fruits and nuts which have been longer cultivated by man.

The Doctrines of Sidis

Nervous Ills, Their Cause and Cure, by Boris Sidis, M. D. Pp. 379; price $3. Boston, Richard G. Badger, 1922.

In this volume Dr. Sidis gives an extended popular presentation of his thesis that mental and nervous diseases are due to perversions of the fundamental instincts of self-preservation and fear. He describes the satisfactory results of his treatment of such diseases by the hypnoidal state. Two chapters devoted to heredity and eugenics respectively are superficial and bigoted. The chapter discussing eugenics is in considerable part made up of a diatribe against eugenists which the author evidently admires enough to quote verbatim (but without citation) from one of his earlier volumes. Numerous interesting case histories are presented.—*P. P.*

STERILITY IN LILIES

A. B. Stout

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THE tendency of many species of lilies to produce seed irregularly, sparingly, or even not at all, is well exemplified in the old familiar Tiger Lily of our flower gardens. This species has been in cultivation in Europe since 1804; it thrives and blooms abundantly over a wide area; it has been observed in cultivation and also apparently wild in its native home (China and Japan) by persons interested in discovering whether fruits were formed. Yet the author is aware of only two references to the pods and seeds of this species, and the accuracy of these is somewhat doubtful. On the other hand, its fruitlessness has repeatedly been observed wherever it has been grown. The Tiger Lily is one of the most striking examples that can be cited of a plant which blooms in abundance but is propagated only by vegetative means.

The Law of Compensation

A ready explanation has long been offered by gardeners and botanists for the condition of sterility found in such plants as the lilies. It has been generally believed that they are physically unable to develop seeds because the bulbs and bulblets use the available food. The tiny embryos were assumed to be virtually starved to death. This explanation of the condition has seemed so obvious and so correct that it has received the sanction of the most critical authorities, and is stated in Darwin's law of compensation and in Goebel's law of correlation. But this simple and apparently very satisfactory explanation we now know to be entirely wrong, at least in its application to the condition of sterility in the lilies. Obviously the best evidence of the truth of this statement is the fact that these usually fruitless plants have been shown to be fully able to produce capsules and seeds. Such evidence is in most cases readily obtained.

Sterility Due to Incompatibility of Pollen

For a period of about fifteen years Focke persisted in attempts to obtain seed of *L. bulbiferum*. He secured bulbs from various parts of northern and western Germany and made many cross-pollinations of their flowers, but obtained at best only a few poor capsules. Finally, bulbs were secured from Switzerland and with the use of pollen of plants grown from them pods and seeds in abundance were matured on the hitherto fruitless plants.[1]

The writer has had much the same experience with other species of lilies. A fine large cluster of *L. croceum*, all descended from a single bulb, growing in the New York Botanical Garden, completely failed to set seed for eight consecutive years. The numerous flowers that appeared each year were self- and cross-pollinated, but there was never even a slight enlargement of any of the ovaries. In 1921, plants of *L. elegans* bloomed at the same time as the cluster of *L. croceum*, and their pollen was used in pollinations. Fine large pods then developed, and these contained many viable seeds. In 1922 these plants of *L. croceum* also yielded pods and seed by cross-pollination with another strain of the same species. Hence these plants were fully able to mature fruit, and their pollen was likewise able to function in certain reciprocal crosses.

[1] Several papers by W. O. Focke bearing on phenomena of self-incompatibility were published between the years 1887 and 1893.

SELF-STERILE, BUT PRODUCING PODS WHEN CROSSED

FIGURE 17. This plant of *Lilium speciosum* is fully self-incompatible, but yields fine pods to pollen from certain other plants of the same species, which presumably indicates their origin from different seeds. This, of course, does not insure compatibility, as plants known to be of distinct seed-origin are often incompatible. Self-incompatibility is also met with when large plantings of fruit trees of the same variety are made. Unless two or more distinct varieties of different seed origin are inter-planted, no fruit is produced.

SEED OF THE SEEDLESS TIGER LILY

FIGURE 18. While the Tiger Lily has thus far failed to yield pods to intra-specific pollination, many have been obtained to pollen of *L. maximowiczii*, as is proved by the two fine pods on the plant at the right. To the pollen of *L. warleyense* only imperfect pods were developed, as shown in the two upturned but partly developed pods on the left. The Tiger Lily is evidently able to produce seed and its usual sterility is due to physiological incompatibility of the pollen used, and is not in any way connected with the fact that the plant habitually reproduces by means of bulbs.

In an effort to discover compatible fertilizations that would produce seed on the Tiger Lily, bulbs of this species have been secured from widely separated localities, some even coming directly from apparently wild plants in China. All plants grown from these have, so far as tested, failed to yield fruits either by self-pollination or by cross-pollination between the different strains. Capsules also failed to form when pollen of such species as *L. canadense, L. supurbum, L. henryi, L. speciosum, L. auratum,* and *L. humboldtii* was used. To pollen of *L. warleyense,* the ovaries of the Tiger Lily began to enlarge and become upturned (see Fig. 18), but the capsules did not develop fully and yielded no seeds. But when pollen of *L. maximowiczii* was used fine pods were readily obtained (see Fig. 18). Potted plants, plants grown in the open, old plants of vigorous vegetative growth, and plants from bulblets blooming for the first time have all produced fine pods from the flowers thus pollinated. Yet on these same plants complete failure resulted from all attempts to produce seed by self-pollination.

It is clear that these usually sterile plants are able to form fruit and seeds and that their pollen is potent, provided there are compatible relations in fertilization. The bulb and the bulblet-forming habits of growth, and of vegetative propagation do not render seed production impossible. The sterility is that of physiological incompatibility in fertilization, a well-marked type which is also seen in numerous species that naturally reproduce exclusively by seeds, and is by no means peculiar to plants that reproduce vegetatively.

In the course of experimental studies with species of Lilium now in progress at the New York Botanical Garden, controlled pollinations have been made for plants of twenty-eight species. In every species thus far studied seed production is decidedly limited by incompatibility in fertilization.

The phenomena of incompatibility are well illustrated by the results obtained with *L. regale,* a splendid and beautiful lily recently introduced from China. Of the ten plants tested, nine were self-incompatible and one was self-compatible. Cross pollination between plants sometimes succeeded and sometimes failed. The same sort of results were also obtained with plants of *L. speciosum, L. candidum, L. henryi, L. parvum, L. tenuifolium, L. humboldtii, L. kelloggii, L. warleyense, L. longiflorum,* and *L. auratum.*

No capsules have yet been obtained on plants of *L. hansonii, L. parryi, L. maximowiczii,* and *L. chalcedonicum,* but in all cases except that of *L. hansonii,* only a few plants have been tested, and these were all obtained from a single source.

Cross-Incompatibility

It is to be noted that crosses between different plants of a species in which there is self-compatibility are also frequently incompatible. One is, however, not at all certain that any two plants of a variety of lily are really of different seed origin, for they both may be the daughter bulbs of a single parent plant, and thus belong to a single clone. If the original plant grown from seed was entirely self-compatible, then one may expect the members of the clone to fail to set seed in crosses. The condition is similar to that encountered in fruit-growing, when an entire orchard of a self-incompatible variety of apple or cherry fails to set fruit unless proper cross-pollination with another variety is provided for. Without doubt it is often the extensive vegetative propagation of a single self-incompatible plant that makes it difficult to secure compatible crosses from apparently different plants of certain varieties of the day lilies and the true lilies.

Seedlings of *L. longiflorum* have been grown to the flowering age in the course of the studies here reported. Many of these were self-incompatible, a few set seed with their own pollen, and many crosses with other plants failed. Such ranges of variation in regard to the compatibilities of sister plants of seed origin are very common in many species.

Other Types of Sterility

There are other types of sterility in the lilies besides that of incompatibility. In certain hybrid varieties. *L. batemanniae,* for example, there appears to be complete impotence, a type of sterility that is very characteristic of hybrids; the spores, both in pistils and stamens, are aborted and functionless in any relation. A one-sided abortion characteristic of intersexes has also been noted in at least one species.

How to Obtain Seed

The principal condition limiting seed production in the lilies is that of incompatibility. When seed is desired from plants that are yielding no seeds because of this condition, it is simply necessary to obtain other stocks of the same species and interplant so that cross-pollination may be effected by insects, or by hand. If the new stock is cross-compatible, seed will readily be produced, but if it is not, seed will not be formed until stock which is compatible is secured. Usually compatible clones may readily be obtained, and often a single planting of commercial bulbs contains such a mixture of stocks, but for certain species and especially for *L. tigrinum, L. hansonii,* and *L. candidum,* it seems somewhat difficult to secure compatible fertilization.

One of the principal sources of failure in establishing a planting of lilies in one's garden is the poor physical condition of bulbs when received. Especially is this true when bulbs are imported. In many species the dormant

RESULTS OF POLLINATION ARE QUICKLY EVIDENT

FIGURE 19. Both of these plants of *L. longiflorum* are self-incompatible and four crosses with other species likewise failed. The three growing pods are from other more successful crosses. The photograph was taken about two weeks after the last pollination was made.

period is very short or is entirely absent. With the death of the top there is usually continued development of the daughter bulbs, and growth of feeding roots. Without doubt the best means of securing healthy and vigorous bulbs, of many species at least, is to grow them locally either from seed or by vegetative propagation, and to transplant so that the bulbs are only out of the ground for a short time, when they are most nearly dormant.

Such excellent varieties as the Easter Lily, the Madonna Lily, Henry's Lily, the Lance-leaved Lily (*L. speciosum*), and the Regal Lily are readily grown from seed. Frequently blooms may be had on seedlings in two years—certainly they may be had in three years. The growing and breeding of lilies from seed presents many interesting possibilities, not only to the commercial growers of bulbs but to the amateur gardener as well.

In lilies the bulb habit of growth does not in the least affect seed production. To obtain seed one must either grow self-compatible plants or grow strains that are cross-compatible. When this is done, seed in abundance may readily be obtained except in the relatively few cases of impotence from intersexes or hybridity.

SELF-STERILITY IN CHINESE CABBAGE

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SELF-STERILITY, in a higher or lower degree, is a characteristic quite common to the plants which bear hermaphroditic flowers and yet are habitually cross-pollinated. Plants of this kind show normal fertility under the natural conditions of flowering, but the amount of fruit is greatly reduced when they are self-pollinated artificially. Such seems the case in grasses, clovers, crysanthemums, sun-flowers, some species of Crucifiers, and a number of other genera. A very fine example of self-sterility is seen in Ulrich's experiment with rye.[1]

This characteristic of the plants mentioned above makes it very difficult for plant breeders to obtain self-fertilized seed of these species, especially in case such seed is wanted in large quantities. Consequently it is interesting and important to study the matter more exactly and to search for a method by which such seed can be produced with greater ease. Bearing this in mind, the author tried an experiment last spring with Chinese cabbage, or *Pe-tsai,* in order to determine the effect of various modes of artificial pollination on seed bearing.

Under natural conditions almost every flower of *Pe-tsai* gives rise to a normal pod, with the possible exception of a few terminal ones on each inflorescence. Therefore, it may be assumed that practically all the flowers experimented with would have been fertile under normal conditions. With this fact in mind, five different modes of artificial pollination were applied, viz:

(a) Flowers covered with paraffin bags, but not pollinated artificially.

(b) Flowers pollinated artificially with pollen of the same flowers.

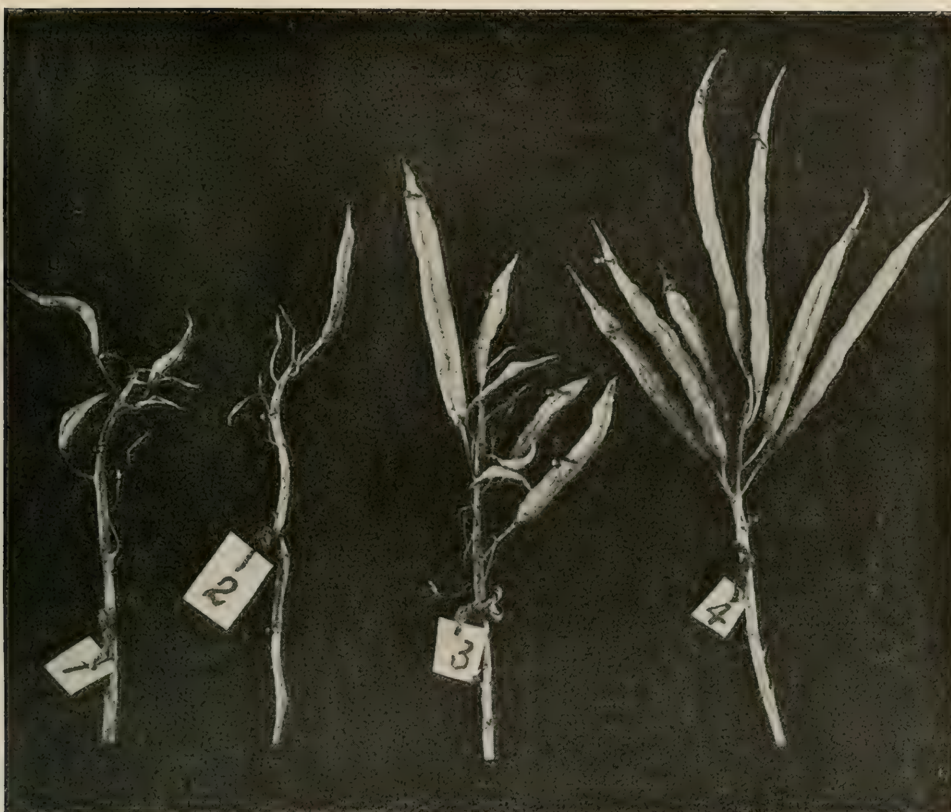
(c) Flowers pollinated with pollen from different flowers in the same inflorescence.

(d) Flowers pollinated with pollen from different inflorescences on the same plant.

(e) Flowers pollinated with pollen from different plants.

The following remarks also must be made as to the technique of the experiment: (1) All of the flowers under control, whether used as male or female in the cross, were covered with paraffined bags before blooming in order to protect them from fertilization by pollen-bearing insects. (2) Those treated with pollen from other flowers (c, d, e) were not emasculated, in order to avoid the experimental errors which might have been caused by faults of the operation. In doing so it was assumed that ovules of a flower would be more readily fertilized by pollen from other flowers, especially that from different plants, than with its own pollen; in other words, the pollen of a flower would actually be more or less handicapped in competition with that from different flowers or plants. (3) After pollination, the flowers were kept under the paper covering for a few days. This treatment did not seem injurious to the development of the pods, because it was found that there was no essential difference in fertility between the flowers which were artificially pollinated with pollen from different plants, and those left to natural cross-pollination.

[1] Ulrich, K. Die Bestaübung und Befruchtung des Roggens. *Inaug. Diss. Halle,* 1902.



POLLINATION IN PE-TSAI CABBAGE

FIGURE 20. On the left (1) are the pods obtained from eleven flowers treated with pollen from the same flower. Next (2) is the single pod obtained when six flowers were treated with pollen from another flower on the same branch. At (3) are shown the pods obtained from fifteen flowers treated with pollen from another branch of the same plant; while on the right are the seven pods obtained by cross-pollination of seven flowers with another plant of the same variety. To self-pollination *pe-tsai* cabbage flowers yielded only about five per cent of perfect pods, whereas ninety-six per cent were obtained by cross-pollination. Apparently there is considerable variation in the extent of self-sterility in different plants, and by selection it may be possible to develop strains that will be nearly one hundred per cent self-fertile.

Discussion

Results of the experiment are shown in the accompanying table.

The flowers pollinated with their own pollen (b), those pollinated with that from different flowers in the same inflorescence (c), and those pollinated with pollen from different inflorescences the same plant (d) gave approximately similar results. About 30 per cent of the flowers treated produced normal pods, 20 per cent produced imperfect pods, while 50 per cent were entirely sterile, and failed to develop at all. Consequently, it may be said that in *Pe-tsai*, different modes of pollination have no effect on fertility, when the pollen used is from the same plant.

Flowers pollinated with pollen from different plants (e) exhibited a very high degree of fertility—96 per cent of the pods being normal—which may be regarded as very near the actual

extreme degree of fruitfulness found in *Pe-tsai* under ordinary circumstances.

When the fertility of the flowers treated with pollen from the same plant (b, c, d) is compared with that of those treated with pollen from different plants (e), it is evident that the intensity of self-sterility, that is, the grade of infertility caused by selfing, is somewhat higher than 50 per cent.

Flowers bagged but not pollinated artificially (a), failed to fruit to a remarkable extent, giving only about five per cent of normal pods. This leads to the conclusion that the flowers of the *Pe-tsai* are so constructed that automatic self-pollination is almost impossible, because the selfed flowers in which pollination had been performed artificially (b), exhibited much higher fertility.

In addition, it should be mentioned that in the group in which the flowers were treated with pollen from the same plant, the individual variations in the grade of self-sterility exhibited a very wide range, all the way from complete fertility to complete sterility being observed. This suggests the possibility of strains occurring in which the percentage of self-sterility is inherently higher or lower than in others. Again, the fact was observed that in some individual plants pollination within a flower and that between different flowers on the same inflorescence was apparently less effective than that between different inflorescences on the same plant (Fig. 20), and so it is not improbable that strains exist which show important differences in regard to the extent of self-sterility. To clear up these points, however, it would be necessary to accumulate more data by further experiments.

Table I. *Effects of Artificial Pollination in Pe-tsai Cabbage.*

Source of Pollen Used	No. of plants treated	No. of flowers treated	Actual Number			Percentage		
			Normal pods	Imperfect pods	Failed to develop	Normal pods	Imperfect pods	Failed to develop
Flowers bagged (a)	12	167	8	11	148	4.8	6.6	88.0
Pollen from same flower (b)	32	423	128	71	224	30.3	16.8	53.0
Pollen from different flowers in the same inflorescence (c)	32	482	113	103	266	23.4	21.4	55.2
Pollen from different inflorescences of same plant (d)	27	331	117	75	139	35.3	22.7	42.0
Pollen from the same plant (b+c+d)	33	1,236	358	249	629	29.0	20.1	50.9
Pollen from a different plant (e)	2	25	24	0	1	96.0	0.0	4.0

DISCOVERY OF THE ANCESTRAL FORM OF DAHLIA JUAREZII

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IT IS a well-established fact that we owe all of our beautiful *cactus dahlias* to a single plant, which was sent to Europe from some unknown locality in Mexico about the year 1863. It bloomed for the first time in 1864 and was figured in the *Gardeners' Chronicle* in 1879. By the cross-pollination of this plant with the types of dahlias previously cultivated, many beautiful forms resulted. From these have descended the varieties which we now call *cactus dahlias* and *hybrid cactus dahlias,* all of which are characterized by long florets, with their lateral margins turning backward instead of forward.

According to the accepted classification of (cactus) growers, *Dahlia juarezii* would be called a *hybrid cactus dahlia.* It resembled in all respects the variety called *Kalif* (Fig. 23). The ancestral wild form, with a single row composed of eight rays, remained unknown until October 21, 1916, when it was discovered by Wilson Popenoe, of the Office of Foreign Seed and Plant Introduction, while on a mission to Guatemala. This primitive species was described and figured by the writer in the *Journal* of the Washington Academy of Sciences, vol. ix, pp. 369 and 370, July 19, 1919. It was named *Dahlia popenovii,* in honor of its discoverer. Its long, spreading, crimson rays, revolute, or turning backward along their margins, can be compared with those of the well-known *Dahlia coccinea,* which is shown with it in the accompanying field photograph made by Mr. Popenoe near San Lucas, Department of Zacatepequez, Guatemala, October 21, 1916.

The specimen of *Dahlia coccinea* in Mr. Popenoe's photograph is an exact facsimile of the original type specimen figured by Cavanilles in 1794, except that it has eight instead of nine rays.

In Mr. Popenoe's notes, dated Antigua, Guatemala, October 23, 1916, is the following entry: "On my way back from Guatemala City to this place I collected some wild dahlias about two kilometers above Santa Lucia, at an approximate elevation of 6,600 feet, where the plants were most abundant. I have not seen them as low as 5,000 feet, but have found them up to 7,000, which is as high as I have gone. I do not know how much higher they may occur. The plants observed near Santa Lucia grow to a height of about four feet. The stem is a dull greenish purple to purplish green, usually glabrous but sometimes with scattering hairs toward the upper portion. Leaves twice-pinnate near the base of the stem, once-pinnate or simple above; leaflets of the lower leaves ovate acute, two and a half inches long, one and a half inch broad, remotely dentate, sparsely furnished with short bristly hairs, which are more scant beneath; rachis not exceeding five inches in length, often very short; petioles absent to three-fourths of an inch long. The flowers are two to three and a quarter inches broad, with eight-rayed florets, the latter sterile and orange brown or crimson in color, in some forms short and broad, in others long and narrow with the margins recurved or revolute, giving to the flower the appearance of a *cactus dahlia,* and contrasting with the other form having broadly spreading flat rays rounded at the tips."

Dahlia juarezii, the ancestor of all our *cactus dahlias,* like *Dahlia pinnata,* the type of the genus, was described from a hybrid plant growing in a state

DAHLIA COCCINEA

FIGURE 21. A reproduction of the figure published in 1794 by Cavanilles with his description of the species. It is nearly a replica of the wild Guatemalan form found by Mr. Popenoe, except that it has nine rays. Unlike *Dahlia juarezii* this species does not cross readily with other species and always comes true to seed, whereas *juarezii* is readily hybridized and is extremely variable.

WILD DAHLIA TYPES

FIGURE 22. These two flowers were collected by Mr. Popenoe near Antigua, Guatemala, in 1916. Above is shown *Dahlia coccinia,* remarkably like the specimen figured by Cavanilles in 1794 (see Fig. 21). The long-petalled, eight-rayed *Dahlia popenovii* is quite different from the "double" flower shown in Figure 23, which corresponds in form and color with the type of the species *juarezii,* the ancestor of our cactus dahlias. Contrary to the usual belief the Aztecs domesticated the wild dahlias found in the mountains of Mexico and Guatemala, and to them belongs the credit for originating the "double" forms.

PARENT TYPE OF THE CACTUS DAHLIA

FIGURE 23. All of our cactus dahlias trace back to a single plant sent to Europe from Mexico about 1863. This plant was also taken as the type of a new species of dahlia, *jaurezii,* but the simpler ancestral form remained unknown until the single, eight-rayed type shown in Figure 22 was discovered by Mr. Popenoe.

of cultivation. The flower-heads of both were "double," and both were ancestors of many varieties. So diverse were the seedlings of *Dahlia pinnata* that it was renamed *Dahlia variabilis;* but according to the rules of priority, its older name must be retained. For the same reason the name *Dahlia rosea,* also a synonym of *Dahlia pinnata,* must also be discarded. The many varieties of dahlias with rounded artificial-looking heads, formerly so common in gardens were all descendents of *Dahlia pinnata. Dahlia coccinea* offered a striking contrast to these in resisting all efforts of plant breeders to cross-pollinate it with them, and also in coming true to seed. Its heads are single; its color varies from scarlet to yellow or brownish red, never verging upon pink or crimson.

The idea has commonly prevailed for a long time that duplex and double forms were the result of recent cultivation; but it is quite certain that they were well known to the Aztecs, who domes-

ticated the wild dahlias of the mountains of Mexico and Guatemala before the discovery of America. Dr. Francisco Hernandez, the celebrated Protomedico of Philip II, sent by his sovereign in 1570 to New Spain to study its resources, figured three dahlias under the Aztec names *Acocotli, Cocoxochitl,* and *Acocoxochitl; cocotli,* like the familiar name *syringa,* signifying a hollow stem, or tube. These names may be translated "water-pipe" or "water-cane;" "cane-flower," or "hollow-stem flower;" and "water-pipe flower."[1] In the Madrid edition of his work (Vol. I, p. 14, cap. 24) Hernandez describes a plant apparently identical with *Dahlia glabrata,* or *Dahlia merckii,* under the heading "De Acocoxochitl, seu flore Acocotli," with flower heads having yellow disks and purple ray-flowers. After which he goes on to say that many other forms of *Acocoxochitl* occur in Mexico, differing from one another in the size and color of the flowers, some of them white, others yellow, others purple or red, others white tinged with purple, or perhaps yellow tinged with red, and a great many other kinds, in some cases with double or multiple whorls or ray flowers, either forming circles or clustered in compact bunches (*manipuli*)."

[1] See Safford, W. E. Notes on the Genus Dahlia, *Journ. Wash Acad. Sciences,* ix: 364. 1919.

Popular German Eugenics

Hygiene des Geschlechtslebens, *by* Dr. Max von Gruber, pp. 116. Bucheri der Gesundheidtspflege Band 13, Stuttgart, Ernest Heinrich Moritz, 1922.

This popularly written little book by a well-known Bavarian eugenist has reached the astonishing circulation of more than 300,000 copies in Germany, and is now in its fiftieth printing. It begins with a brief but well written consideration of reproduction, heredity and selection, and the point of view of eugenics is that presented throughout the volume.—*P.P.*

A Psychological History of Mankind

Elements of Folk Psychology, by Wilhelm Wundt. Authorized translation by Edward Leroy Schaub, Ph. D., Professor of Psychology in Northwestern University. Revised Edition; pp. 52. New York, The Macmillan Co., 1921.

This book was first published in Germany in 1912. Professor Schaub's translation appeared in 1916. The extent of the revision is not stated.

Dr. Wundt's point of view is, of course, well known to all special students. This volume contains a great mass of material of interest to all who are concerned with the evolution of man. The almost total lack of reference to original sources deprives it of some of the value which it would otherwise have to the eugenist.—*P. P.*

EUGENICS IN GERMANY

THE German Society for Race Hygiene, founded in the same year (1905) as the American Genetic Association, has been generally recognized as the spokesman for a scientific view of the population problem in Germany. At its meeting in Munich last October, it issued a revised statement of its principles. This supersedes the "theses" adopted at the Jena meeting[1] in 1914, and special students will find it interesting to compare the two statements. In general it may be said that they show no radical points of difference, but an attempt has been made to produce a more comprehensive platform, in the new version.

The "Leitsatze der Deutschen Gesellschaft fur Rassen-hygiene" now stands as follows:

1. The chief danger to which every people is exposed is deterioration through the decrease of vigorous and useful racial elements.

2. A people can survive in the struggle for existence only if it comprises a large proportion of physically and mentally well-endowed men and women, of good character and morals.

3. The health, vitality, and cultural productivity of a population are not dependent on conditions of the environment (nourishment, education, infectious diseases, etc.) alone, but fundamentally also on inherited tendencies.

4. The heritable constitution of a people is not unchangeable. It can be turned in undesirable directions by two different methods: (a) through dysgenic selection, which leaves the more capable members of the population behind the less capable in respect of reproduction; (b) through direct injury to the germ-plasm, by racial poisons.

5. At present among civilized peoples a dysgenic selection actually exists to a very large extent.

6. The social ascent unfortunately brings with it, under present-day conditions, real danger of the dying-out of families.

7. The inadequate reproduction of those members of society who by hereditary endowment are best qualified for leadership is of the most ominous import to the future of the race.

8. The most important problem of race hygiene is therefore the preservation of socially valuable families in all classes of the community.

9. Inadequate reproduction is at present more frequently a result of deliberate birth-prevention, than of unwilled causes (venereal diseases, etc.).

10. Since not all children born attain the age of reproduction, the two-child system leads in a few generations to the disappearance of families. On the average, three children are scarcely sufficient to perpetuate the family.

11. The motives for birth-prevention are principally of a social and economic nature, and race-hygiene must therefore in the first place strive for social and economic reforms calculated to destroy or at least diminish the prejudice, among sound and capable married couples, against a sufficient number of children.

12. In tax legislation really adequate attention must be paid to the size of family. At the very least, each income and each estate must be divided (for purposes of taxation) into as many equal parts as there are members of a family.

13. From inheritance taxes families of three or more children should be entirely exempt, except in the case of excessively large estates.

[1] Printed in the *Journal of Heredity*, v: pp. 435-6, October, 1914.

14. A eugenic basis for inheritance taxation of rural real estate is particularly important. Otherwise it is to be feared that even the present landed families will no longer be able to have a sufficient number of children.

15. In the formation of farm colonies care must also be taken that the settlers are allowed to have or to expect an adequate progeny.

16. The encouragement of rural and suburban settlements is also of importance to race-hygiene.

17. A population policy directed toward a lower birth-rate, in accordance with neo-malthusian ideas, endangers eugenics, because it has been found that the decrease in births takes place especially among the most valuable families.

18. A purely quantitative population policy, on the other hand, which attempts to increase the number of births without taking account of the differences of inherited capacity, also tends toward decreased racial fitness, because all such measures lead especially to an increase in the birth-rate of the eugenically inferior.

19. The eugenic point of view should be given due consideration in all assistance extended to families having numerous children.

20. Special pay-allowances, based on the size of family, among government officials are only justified eugenically, if a sufficiently careful selection is employed in the appointment of these officials.

21. The family allowances should be considerably larger than hitherto, in proportion to the base-pay. At present, especially among higher officials, the child allowances remain much below the actual cost of bringing up children.

22. The best foundation of a people is an assured permanency of well-stratified families. The interest of the state therefore demands generous protection of the family.

23. All efforts tending to loosen the natural bonds that unite members of a family, especially those which lead to premature separation of mother and children, are to be combated as dangerous to the family and therefore to the nation.

24. For the perpetuation of our race, a union of as many capable families as possible from all strata of society, for the fostering of the eugenic attitude and for mutual aid, is desirable.

25. Delayed marriage in professions requiring lengthy preparation is eugenically unfavorable. The period of preparation should therefore be abbreviated as much as possible. In particular, a schooling of 12 or 13 years is too long. The members of every profession ought to be in a position to marry by the age of 25.

26. The eugenic bearing of the German marriage law, hitherto limited to the prohibition of marriage between the closest blood relatives and to the distribution of official blanks for publication of marriages, is inadequate.

A broadening of the marriage prohibition on eugenic grounds is to be hoped for in the future, but seems unattainable at present.

But without forbidding marriage, careful investigation of all applicants for marriage licenses is already practicable, and its legal introduction should be sought immediately.

27. The time seems not yet to have arrived among us for compulsory sterilization of the feebleminded and other defectives.

28. The sterilization of defective individuals by their own wish or with their consent should be regulated by law at once.

29. In order to prevent the reproduction of anti-social and other very defective individuals, their segregation in labor colonies, which can be made self-supporting by the work of the members, should at once be legally provided for.

30. The indiscriminate and widespread practice of abortion has an overwhelmingly dysgenic effect.

31. In order that the population may be intelligently advised on questions relating to reproduction, well-informed men and women ought to be appointed by the state as counselors on marital and family affairs.

32. Decision as to the permissibility of such matters as the termination of pregnancy ought to be reserved for special boards of investigation representing diverse professions whose information on the subject may be pertinent.

33. So long as prohibition of the consumption of beverages containing more than two per cent alcohol is not attainable among us, a system of cards, such as obtains in Sweden, ought to be introduced. Drinks containing less than two per cent alcohol should be freed from internal revenue tax.

34. To present measures for controlling venereal diseases should be added a system of confidential reporting, especially for syphilis, with compulsory treatment and provision for free treatment where necessary. A carefully guarded official register should be kept of all syphilitics, whereby their cure, and later fitness for marriage, can be determined better than hitherto.

35. The maintenance of a health register for the entire population, with investigations at appropriate intervals, should be introduced as soon as possible.

36. Better physical culture of our people will lessen the ignorance of all, even of the most cultured, as to the fitness or degeneration of the race.

37. We therefore urge the introduction of race-hygiene instruction in the high schools.

38. The older pupils in the higher elementary schools (middle schools) should have been already given a eugenic point of view, in connection with their general health teaching.

39. All candidates for the teaching profession should receive education in health, including race hygiene, and should have proved their understanding of it by passing an examination.

40. To further teaching and research in race hygiene, governmental institutions on the plan of the Swedish should be established.

41. The renovation of our whole outlook on life (*Weltanschauung*) is of decisive importance. The welfare of the family, even in distant generations, must be recognized in the vision of all as a higher good than mere personal comfort; and in governmental policies the needs of the present must not obscure the future of our race.

—*Paul Popenoe.*

The Physiology of Psychology

ELEMENTS OF SCIENTIFIC PSYCHOLOGY, *by* KNIGHT DUNLAP, Professor of Experimental Psychology in Johns Hopkins University. Pp. 368; price $3.50. St. Louis, C. V. Mosby Co., 1922.

Leaving behind the old introspective psychology, and avoiding some of the modern mystical schools, Professor Dunlap has presented the foundations of the subject largely from a physiological point of view. Little space is devoted to individual differences and other subjects in which genetics is particularly involved, but the brief mention given to heredity is well phrased.—*P.P.*

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HEREDITY IN THE HONEY BEE

A CASE OF TWINNING IN DAIRY CATTLE

HEREDITARY NOTCH IN EARS OF JERSEY CATTLE

MATRIMONIAL VIEWS OF UNIVERSITY STUDENTS

MICROCEPHALIC PEOPLE CALLED "PIN HEADS"

ORIGIN OF FALSE WILD OATS

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BY THE

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Date of Issue—Sept. 30, 1922

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CHANTECLER POULTRY

TRABUT—PLANT BREEDER

AN HISTORIC ORANGE TREE

BROTHERS IN RUGBY FOOTBALL

PARENTS' AGE AND QUALITY OF OFFSPRING IN COWS

INTELLIGENCE AND SCHOOLING

RUST RESISTANT OATS

PUBLISHED MONTHLY AT MENASHA, WISCONSIN
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The Journal of HEREDITY

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Date of Issue—Dec. 12, 1922

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Volume XIII, Number 6 June, 1922
Date of Issue—February 15, 1923

TWO DECADES *of* PROGRESS IN GENETICS

The discoveries about heredity made during the years that genetics has been approaching its majority only preclude the greater discoveries to come. The long strides that have been made in so short a time leave no doubt that this new science is of vast importance to mankind. Life is most vitally interesting to all of us, because we are all alive. The object of the JOURNAL is to give the absorbing facts about life, and how it is continued from one generation to the next, in all its marvelous forms.

The members of the association are already aware of the great influence these discoveries are having on the future of the race. During the early days of the science this association was organized to make these discoveries available to a wider public. Throughout these years our membership has grown steadily, but to do more effective work it is necessary that it be made large enough to make the Association financially independent.

Every member has friends who would be glad to join the association if the objects for which [it] stands were explained to them. If each of us would interest even one of our friends in this subject, and induce him to become a member, it would mean a better, bigger, more useful JOURNAL.

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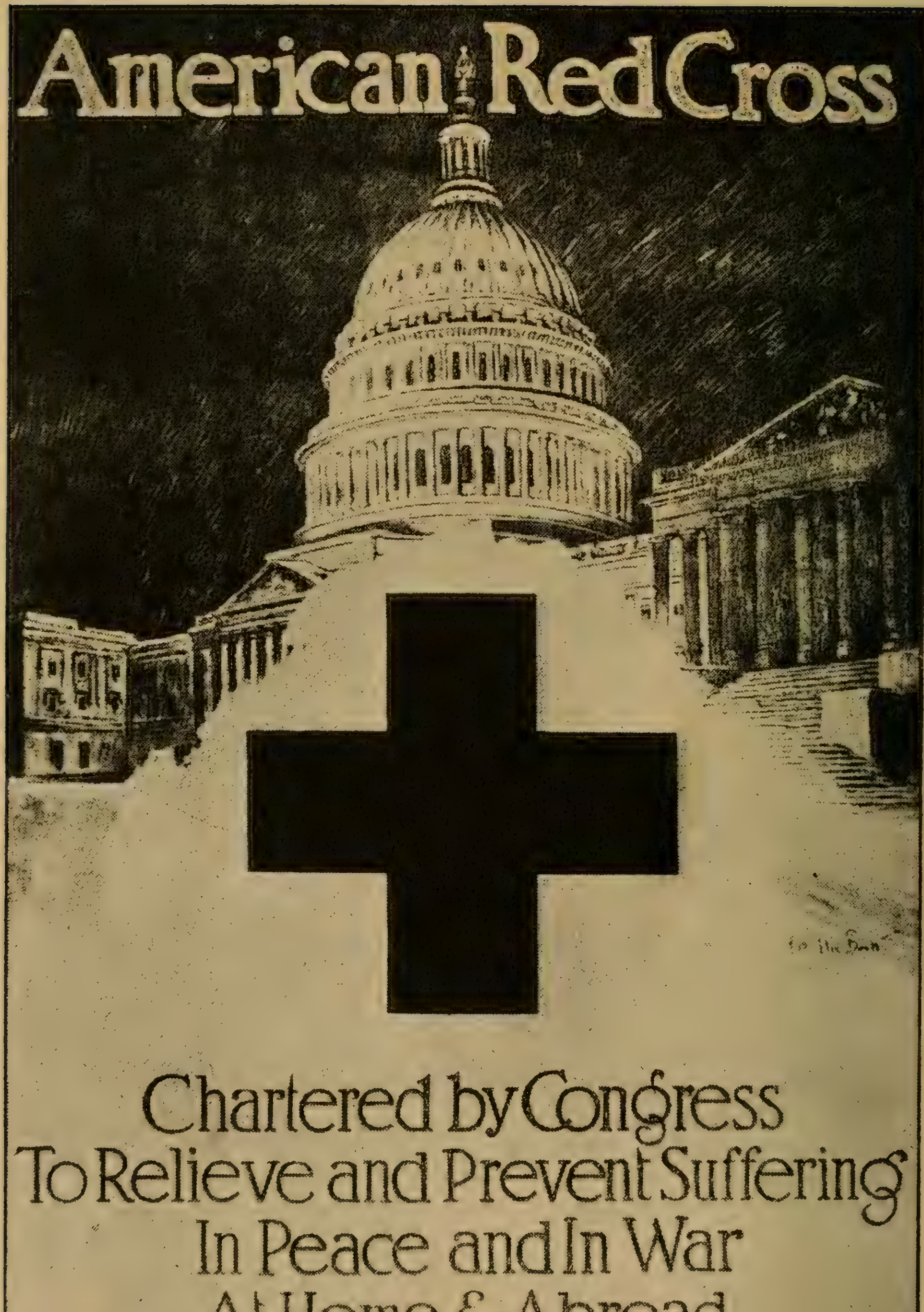

ANNUAL ROLL CALL - - NOVEMBER 11-30, 1922

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The American Genetic Association

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SPECIAL NOTICE TO MEMBERS
(INSIDE FRONT COVER)

PUBLISHED BY THE
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BALTIMORE, MD. AND WASHINGTON, D.C.

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Date of Issue of this Number, April 25, 1923

SPECIAL NOTICE TO MEMBERS

A new ruling by the Postoffice Department requires that the Journal of Heredity be issued on time hereafter, under penalty of being no longer entitled to second class mailing priviledges. At a special meeting of the Council of the Association it was, therefore, decided that the best course open to us is to close the present volume with this number, designating it August to December, 1922, while the next number will be Number 1 of Volume XIV, January-April, 1923. The May issue will appear on time, and Volume XIV will contain nine numbers.

In order that members will not lose by this change all dues will be set ahead six months, so that memberships which ordinarily would expire with the publication of the January issue will not fall due until the July number appears.

The Council regrets exceedingly that it will be impossible to carry out our program of making up the numbers we are behind, but since the loss of second class mailing priviledges would necessitate discontinuing the Journal immediately, it is evident that drastic action has been necessary.

Monumental Printing Company, Baltimore, Md.

NOMINATION FOR MEMBERSHIP in the American Genetic Association

The Association is dependent on the support and active assistance of its members to carry on its work. Haven't you friends who would be interested in this new science of genetics and who would like to learn more about it through the Journal of Heredity? We will be delighted to tell them about the Association if you will give us their names.

Secretary, the American Genetic Association,
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Washington, D. C.

I desire to nominate..

Street ....

City ....

State or County ....

for membership in the American Genetic Association.

Nominated by..Member A. G. A.

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Monumental Printing Company, Baltimore, Md.

A CHANGE OF PRINTERS

IT GIVES the management of the JOURNAL OF HEREDITY pleasure to announce that arrangements have been completed that will enable us to put the JOURNAL more promptly into the hands of its readers than has been possible of late. Printing the JOURNAL at Manasha, Wisconsin, resulted in greater efficiency during the reconstruction period, but later developments have made the arrangement unsatisfactory. Beginning with this number, the JOURNAL will be printed at Baltimore, Maryland, and this change should make possible its publication at more frequent intervals, so that it will be issued *on time* before very long.

The Association has installed a new mailing system, and careful revision of the mailing-list is being undertaken. We are very anxious to correct any errors, and would greatly appreciate having members check their address on the wrapper of the JOURNAL, and notify us of any corrections that should be made.